HANDBOOK OF FORECASTING TECHNIQUES

A REPORT SUBMITTED TO

THE U.S. ARMY ENGINEER
INSTITUTE FOR WATER RESOURCES
KINGMAN BUILDING
FORT BELVOIR, VIRGINIA 22060

PART I
LIST OF 73 TECHNIQUES

AUGUST 1977

SUPPLEMENT TO
IWR CONTRACT REPORT 75-7

HANDBOOK OF FORECASTING TECHNIQUES.

PART I.

LIST OF 73 TECHNIQUES.

A Report Submitted to:

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Under:

Contract No. DACW31-75-C-0087

AUGUST 1977

Supplement to IWR Contract Report 75-7

Copies may be purchased from:

National Technical Information Service
U.S. Department of Commerce
Springfield, Virginia 22151

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UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Supplement to IWR Contract Report 75-7 (Part 1)	2. GOVT ACCESSION NO. / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Description of 73 Forecasting Techniques	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Arnold Mitchell, et al.	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Center for the Study of Social Policy, Stanford Research Institute, Menlo Park, California 94025	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer Institute for Water Resources, Kingman Building, Fort Belvoir, Virginia 22060	12. REPORT DATE: August 1977 / 13. NUMBER OF PAGES: 74
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report): UNCLASSIFIED / 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Forecasting, technological forecasting, time series projection, simulation models, qualitative forecasting

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This Supplement to the Handbook of Forecasting Techniques (IWR Contract Report 75-7) is in two parts: Part 1 consists of brief descriptions of the 73 forecasting techniques presented to a group of Corps planners for selection for inclusion into the Handbook. Each technique is explained in a one-page description designed to answer simple questions such as: What is it? What do you get? How do you do it? and What do you need? This part should prove to be a valuable reference to the users of the Handbook in terms of coverage and format of presentation.

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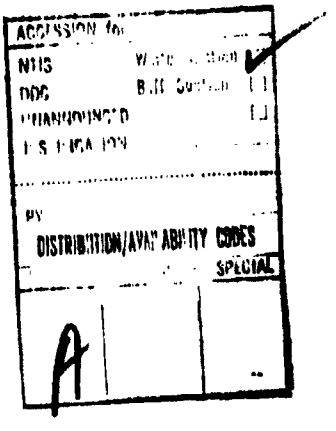
INTRODUCTION

This Supplement to the Handbook of Forecasting Techniques (IWR Contract Report 75-7) is in two parts: Part 1 consists of brief descriptions of the 73 forecasting techniques presented to a group of Corps planners for selection for inclusion into the Handbook. Each technique is explained in a one-page description designed to answer simple questions such as: What is it? What do you get? How do you do it? and What do you need? This part should prove to be a valuable reference to the users of the Handbook in terms of coverage and format of presentation.

Part 2 of the Supplement contains 31 forecasting techniques described in some detail. These techniques were selected from the 73 listed in Part 1. Twenty-five of these 31 techniques were finally collapsed into 12 for more detailed treatment in the Handbook. This part should also be a valuable addition to the Handbook because it provides easy-to-read but informative discussion of the most popular techniques used by forecasters.

The material presented in the Supplement was prepared by the Center for the Study of Social Policy, Stanford Research Institute and was provided IWR as a byproduct of the research contract that produces the Handbook. Funds for printing the supplement are from OCE (CWP-S).



List of 73 Forecasting Techniques

Cost-Benefit Analysis

Statistical Models (Bayesian)

Marginal Analysis

KSIM

Mission Flow Diagrams

Parameter Analysis

Cross-Impact Matrix

Input-Output Analysis

World Oil Price Simulation

Breakthroughs

Precursor Events

Econometric Forecasting

Dynamic Models

Structural Models

Decision Theory

Morphological Modelling

Decision Matrices

Relevance Trees

Theoretical Limits and Barriers

Analysis of Industrial Behavior

Technological Audit

Social Trend Analysis

Scenario Writing

Canonical Trend Variation

Surprise-Free Projections

Social Indicators

Leading Indicators (Economic)

Change Signals Monitoring

Critical Factors Analysis

Estimates of Preferences

Subjective Estimates of Probability

Prediction of Change-Over Points

Amplitude-Adjusted Index

Diffusion Index

Authority or "Genius" [illegible]casting

Surveys of Intentions or Attitudes

Surveys of Activities or Units

Panels

Delphi

Psychographics or Life Style

Activities, Interests, Opinions

Life Ways

Historical Analogy

Alternative Futures (FAR)

Divergence Mapping

Introspective Forecasting

Utopias/Dystopias

Modes and Mechanisms of Change

Study of Forces of Change

Macro Historical Cycles

Cross-Cultural Comparisons

Synectics

Brainstorming

Bionics

Science Fiction as Forecasts

Exponential Smoothing

Simple Regression

Moving Averages

Multiple Regression

Envelope Curves

Growth Curves

Link-Relative Prediction

Box-Jenkins

Cycle Analysis

Environmental Systems Analysis

Risk Analysis Simulation

Contextual Mapping

SRI Gulf Energy Model

Games

Policy Capture

Probabilistic Forecasting

Normex Forecasting

Substitution Forecasting

FORECASTING EVALUATION FORM #1

What is it?

Name: BENEFIT-COST ANALYSIS

Definition/description: A technique to measure the costs of an alternative course of action to achieve some objective against the benefits resulting from taking that course.

History/degree of provenness/promise: As a tool for government policy, C/B was first adopted by Corps planners using procedures described in the famous "Green Book". C/B associated with system analysis had greatest development in the Department of Defense during the administration of Secretary McNamara.

WHAT DO YOU GET?

Uses and limitations: Where important factors in a problem cannot be measured in monetary terms, or where such measurement is very difficult and uncertain, cost benefit analysis can be very useful.

Form(s) of Output: Lists of alternatives in order of preference based on specific criteria. Also, monetary values of estimated costs and benefits for each alternative and the ratio of C/B for each.

Level of Detail: Can be tailored to fit a particular problem and is uniquely constructed for that problem.

Level of Confidence: High when good data are combined with intuitive insights.

Span of Forecast: Short- to long-range forecasts. Often cover 20 years.

HOW DO YOU DO IT?

Procedures: Yes, but not "cut and dry". Requires invention on the part of the analyst.

1. Identify promising alternatives
2. Design the models and criteria
3. Assess the Costs (-) and Benefits (+)
4. Apply the criteria

WHAT DO YOU NEED?

Data requirements and availability: Problem dependent but always need costs for certain components and subjective estimates for others.

People, Including Organizational Back-up: Wide range of costs and people, from single analyst with a pencil to large teams utilizing computer backup.

Time: Several weeks to several years.

Money: Medium to high (?)

(Wheelwright, p. 174)

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: STATISTICAL MODELS (Bayesian)

Definition/description: Bayesian statistics allows one to establish certain confidence intervals and statistics that can be used to check the validity of a model.

History/degree of proveness/promise: "Mathematical sound"
Power: Complementary to other forecasting techniques. Can actually be used with decision analysis as a subjective probability estimate.

WHAT DO YOU GET?

Uses and limitations: Forecasts in which historical data is not available. Allows one to deal with uncertainty in a decision-making situation. Forecasts based on subjective probability estimates and a statistical model - generally Bayesian statistics.

Form(s) of Output: "Knowledge is power only if man knows which facts not to bother with." Entire range of possible values - lots of output; maybe overwhelming. Should be done in stepwise fashion--a little data, then evaluate...

Level of Detail: Specific, detailed, numerical results.

Level of Confidence: Analyses are only as reliable as the probabilities assigned to the various events.

Span of Forecast: Short-term.

HOW DO YOU DO IT?

Procedures: Yes.
1. Draw the decision tree.
2. Determine the values of each path.
3. Assign the probabilities to the uncertain events.
4. "Calculate" the expected values (Foldback or Monte Carlo).
5. Identify best action to take.

WHAT DO YOU NEED?

Data requirements and availability: Can be based on information that already exists within the "office," or of which the planner doing the estimating is aware. Availability problem in working across organizational lines to get estimates from others.

People, Including Organizational Back-up: Requires the users to have a better understanding of statistics and mathematics than do nonstatistical models.

Time: Manager's time plus training and guidance in developing the ability to make subjective probability estimates.

Money: Cost mainly associated with "decision-maker's" time.

Steiner 1969

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: MARGINAL ANALYSIS

Definition/description: A technique for optimizing output with a given input. Focuses attention on the question: What difference does the next move make? It accentuates the variables in a situation and underplays averages and constants.

History/degree of provenness/promise: Used prior to 1963 by Continental Air Lines. It seems to work.
Promise: I do not see Corps application.

WHAT DO YOU GET?

Uses and limitations: Used whenever it is possible to calculate the marginal cost of doing something versus the marginal return, such as optimizing business profits by pricing goods and services, or determine worthwhileness. Limitation: Getting accurate data about the impact of making a decision to produce or not to produce that last unit.

Form(s) of Output: Comparison of marginal cost versus marginal return for a specific question.

Level of Detail: Detailed and specific.

Level of Confidence: Better than trend extrapolation when applied to correct situation. Can be a guide to increase profits when the marginal difference can be calculated.

Span of Forecast: Short-term.

HOW DO YOU DO IT?

Procedures: Not stated in Steiner.

WHAT DO YOU NEED?

Data requirements and availability: Requires data about incremental income and costs.

People, Including Organizational Back-up:

Time: }
Money: } Guess: - low level of effort and money.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: KSIM

Definition/description: Simulation technique that allows a group of "experts" from different disciplines to evaluate the interactions among variables and test alternatives.

History/degree of provenness/promise: Developed by Dr. J. Kane, University of British Columbia, 1970. Some 15 reported useful applications. Great promise.

WHAT DO YOU GET?

Uses and limitations: Useful in problem formulation, needs identification and communication. Allows planners to understand system structure, relate quantitative and qualitative factors, and communicate the outcome of proposed planning interventions.
Limitations: Aggregate variables, and structural relationships and does not give precise numerical answers.

Forms(s) of Output: Time series data of system variables over time and/or plots.

Level of Detail: Aggregate (8-10 variables)

Level of Confidence: A little better than pure judgment, with the utilization of statistical data.

Span of Forecast: Long-term.

HOW DO YOU DO IT?

Procedures: Yes.
1. Define the problem
2. Select the variables
3. Cross impact
4. Refine model
5. Test alternatives

WHAT DO YOU NEED?

Data requirements and availability: Some quantitative data required. Usually readily available.

People, including Organizational Back-up: "Experts" from 4-10 disciplines. Computer program and on-line capability.

Time: 1 week workshops average

Money: medium ($5K)

Normative Martino 1972, p. 317-330

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: MISSION FLOW DIAGRAMS

Definition/description: A normative or goal-setting method of forecasting, used to identify bottlenecks which prevent the realization of otherwise promising paths. These bottlenecks can then serve as targets for advancement efforts.

Definition/description: A normative or goal-setting method of forecasting.

History/degree of provenness/promise: Devised by Dr. Harold Linstone. Subjective process unknown degree of provenness. Need more information. Promise: Likely to appeal to Corps.

WHAT DO YOU GET?

Uses and limitations: Analysis of any sequential process to identify difficulties and costs associated with each route. Also test new routes. Performance requirements can then be derived and used as normative forecasts. "Tend to organize and structure the problem and assure completeness." Therefore, disadvantage: impose rigidity that may distort problem. Also numbers, no matter how subjective, tend to create their own validity.

Form(s) of Output: Flow Diagrams showing many paths from Point A to Point B.

Level of Detail: Problem dependent: from aggregate to detailed. Technique is flexible.

Level of Confidence: Subjective and depends upon the individuals making the decisions.

Span of Forecast: Again, problem dependent: short-term to long-term. Major application may be in framework studies.

HOW DO YOU DO IT?

Procedures: Mapping all the alternative routes or sequences by which some mission or task can be accomplished. Alternative routes, not currently available, may be postulated, for which normative forecasts are then developed. Numerical weights similar to PATTERN can be assigned to alternative paths of a mission flow diagram. (What is PATTERN? See Wheelwright, p. 17?.)

WHAT DO YOU NEED?

Data requirements and availability: Need to check other sources.

Quinn, 1967

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: Demand Assessment (Darracott, 1967, p. 4-44) nothing.
PARAMETER ANALYSIS - Quinn, James B., "Technological Forecasting," Harvard Business Review, Mar/April 1967.

Definition/description: A way to structure thinking for short-term technical changes.

1. Demand Assessment--Corps might relate, but little or no structure.
2. Theoretical Limits
3. Parameter Analysis--sounds good.

History/degree of proveanness/promise: Used by RAND in the early 1960's.

WHAT DO YOU GET?

Uses and limitations: Predicting Technological Changeover Points
Analyzing Unique Properties of a Product
Trends in Plotting Technical-Economic Performance
Analyzing Substitution Growth Curves

Form(s) of Output: Plotted or tabular range of costs for various alternatives.

Level of Detail: Detailed costs.

Level of Confidence: Judgmental and data dependent. No feedback built in for review.

Span of Forecast: Short-term detailed studies.

HOW DO YOU DO IT?

Procedures: Yes:
1. Select performance characteristics (one to three) which can be quantified.
2. Include ranges and most likely values
3. Identify precisely the phase
4. Document the major assumptions
5. Include best estimates or probability

WHAT DO YOU NEED?

Data requirements and availability: Present cost and expected future changes must be specified.

People, Including Organizational Back-up: Economist. Data an[illegible]

Time: Medium

Money: Low to medium.

Corps Value: Low, unless more details can be obtained.

Mixed

Martino 1972, p. 271-286

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: CROSS-IMPACT MATRIX

Definition/description: Comparison of individual forecasts, on a pair-wise basis, to determine whether there are any interactions; or provides a systematic method for examining the interactions among several forecasts.

History/degree of provenness/promise: Devised by T. Gordon and O. Helmer in the late 1960's. Numerous applications--it works. High degree of promise.

WHAT DO YOU GET?

Uses and limitations: Comparsion of forecasts and testing policies. Provides greater clarification of issues and better definitions of the risk and uncertainties in the subject being forecast, as well as a more complete and consistent picture of some future time period.
Limitations: Number of forecasts and possible method inflexibility.

Form(s) of Output: A matrix of events in rows and columns depicting the interaction between events.

Level of Detail: While extensive detail is possible (over 25 events), the procedure becomes tedious and evaluation complex.

Level of Confidence: Judgmental, but use of experts and probabilities provides for extensive feedback and review.

Span of Forecast: Flexible (long- or short-term) and determined by nature of events.

HOW DO YOU DO IT?

Procedures: Yes, very systematic. Events are suggested with probabilities and year of occurrence. Events are then arranged in columns and rows. The interaction between events is shown in terms of mode (enhance, enables,...prevents); strength (10%...100%) and time lag (immediate...x years).

WHAT DO YOU NEED?

Data requirements and availability: Forecasts - the source of these is after delphi or panel but can be from any source.

People, Including Organizational Back-up: Need "experts" to determine events, probability and time of occurrence. Also, must evaluate the interactions among events.

Time: 1 day to 1 year, depending upon complexity: median 1 month.

Money: Range: modest to high. Depends upon complexity of events, type of "experts" and whether a computer is utilized.

Chrisholm & Whitaker 1971
Wheelwright 1971, p. 141

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: INPUT/OUTPUT ANALYSIS

Definition/description: I/O Analysis is a descriptive model of an economy. It is a form of national income accounting that summarizes all "taking" and "giving" among and within all industries and between them and the final consumer.

History/degree of provenness/promise: O.K. for a short-term, "precise," bunch of numbers and an extremely narrowly defined objective--Corps will like it. Can help planners determine if material goals can be achieved, i.e., increasing residential construction will require steel, cement, bricks, trucks, cranes, machinery, glass, wood, etc. How much will it cost and what changes will have to be introduced to meet objectives?

WHAT DO YOU GET?

Uses and limitations: I/O main usefulness is for planning purposes at the level of a national economy. Main value in planning rather than forecasting. Limitations: Based on linear homogeneous production function and the assumption that I/O coefficients have not changed--good luck. Works better in France or USSR, since I/O basically assumes a constant technology.

Level of Detail: Extremely detailed.

Level of Confidence: Used to have high level of acceptance. However, current economics situation tends to lower confidence in "economics" in general. Results as good as the input data.

Span of Forecast: Broad range of applications--short detailed to medium.

HOW DO YOU DO IT?

Procedures: Well-structured mathematical analysis (matrix inversion).

WHAT DO YOU NEED?

Data requirements and availability: Based entirely on available and manipulated data. While extensive data required, it is generally available. Problem is getting the data in a consistent form and agreeing on level of aggregation and what to include.

People, Including Organizational Back-up: Economist. Data Analyst. Mathematician. Usually required computer application.

Time: Medium to long (1 year)

Money: Medium to expensive to construct.

Personal Communication with
Steve Coles, SRI

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: WORLD OIL PRICE SIMULATION (WOPS)

Definition/description: Combines several forecasting techniques: econometric model, dynamic simulation, heuristic overlay (programmed to learn), and computer/analyst interaction.

History/degree of provenness/promise: Under development. Initial testing to be completed by February 1975.

WHAT DO YOU GET?

Uses and limitations: Forecasts world oil prices. Main application for planning and policy decisions in setting prices.
Limitations: Single purpose, untested.

Form(s) of Output: Graphs of price strategies for maximum total discounted (net revenue)

Level of Detail: Aggregate: Five sectors for the whole world.

Level of Confidence: High level of confidence.

Span of Forecast: Medium - 10 years (1985)

HOW DO YOU DO IT?

Procedures: Computer/analyst dialogue. Using PDP10 computer. Interactive simulation routine.

WHAT DO YOU NEED?

Data requirements and availability: Entire data base on line, however, not available.

People, Including Organizational Back-up: To build the system requires a large team of analysts, programmers, economists, and planners.

Time: 9 months, development.

Money: $50,000, development. User costs not yet established.

Subjective Martino 1972, p. 210-249

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: BREAKTHROUGHS

Definition/description: Systematic seeking out of precursor events in order to identify potential signals in hypothesizing a pattern or breakthrough. A breakthrough is something which appears to transcend prior limitations.

History/degreeof provenness/promise: At least since 1970. One application sited. Also used by Kahn and Wiener. High degree of promise as information discrimination increases. (used by LRPS and CEH at SRI).

WHAT DO YOU GET?

Uses and limitations: Primary purpose is analysis, not data gathering, used to watch for technological breakthroughs and to obtain warning of any other shifts in the environment which might affect "the business."
Limitations: No "sure way" to assign threshold. Difficulty in separating signals from noise.

Form(s) of Output: Folders of clippings.

Level of Detail: Study dependent, but no limits inherent in the technique. Files can be extremely detailed or quite aggregate.

Level of Confidence: Judgmental.

Span of Forecast: Identification of new patterns (long-term).

HOW DO YOU DO IT?

Procedures: collection: information enters the system by collecting data in specified sectors from prospective sources.
screening: based on needs and goals
evaluation: sketching patterns and purging
threshold setting: balancing the risk of actions where there is no need, and failing to act when action is required.

WHAT DO YOU NEED?

Data requirements and availability: News clippings, magazine articles, speeches, patents, etc. Utilizes what is available.

People, Including Organizational Back-up: Low level of effort.

Time: From few months to a continuing activity.

Money: Modest. Corps may consider organizing their existing clipping files and initiating procedures to collect items from personnel.

Noise: false alarms.

Signals: Potential breakthroughs.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: PRECURSOR EVENTS

Definition/description: A precursor event is any observable event or development in technology, economy, politics, or society which clearly will cause another, subsequent future event. EXAMPLE: The number of babies born in the U.S. in 1974 will heavily determine the number of 20-year-old Americans in the year 1994

History/degree of provenness/promise: As a forecasting method, the identification and analysis of precursor events has been given most attention by technological forecasters, especially military forecasters in the 1950s and 1960s. The method shows great promise and is rather well-proven in specific instances, studied in retrospect.

WHAT DO YOU GET?

Uses and limitations: USES: Where they can be identified and related to phenomena of interest, they provide an early-warning and strategic planning tool. LIMITATIONS: Outside of physical technology, identification of a precursor event and a solid linkage of it to phenomena of interest is apt to be difficult.

Form(s) of Output: A description of the event (actual as it happens, or theoretical--what to watch for), together with an explanation of how it is linked with the phenomena of interest, and the probable timing/impact of the event on what is of interest.

Level of Detail: In technological matters, detail may be rich, exact. In economic, social political matters the description is more apt to be a fuzzy image.

Level of Confidence: Highly reliable where solid and well-known cause-effect mechanisms are present. In other cases, the precursor event is apt to be limited in utility to the role of a supporting indicator.

Span of Forecast: Dependent on the time-frame of the explanatory mode. EXAMPLE: Diffusion of a technological innovation in general is known to take about 15 years. Thus an innovation today may have implications for events over the next 15 years.

HOW DO YOU DO IT?

Procedures: Primarily a matter of literature review, personal contacts with informed experts in fields of interest. In some cases, theoretic predictive models imply or suggest precursor events to search for.

WHAT DO YOU NEED?

Data requirements and availability: REQUIREMENTS: One needs an explanatory model about the inter-relations among events of interest, identification of and access to pertinent literature and experts, and analysts experienced in the field who are also skilled in the art of imaginative yet plausible and logical conjecture. AVAILABILITY: Varies widely from field to field--best in technology, worst in sociology.

People, Including Organizational Back-up: At least one qualified analyst, and access to pertinent sources of literature and information.

Time: Depends on the scope and scale of the topic definition. A quick first pass might take 1 man-week. A full-blown program for a fairly comprehensive topic might require 1 man-year, or even more.

Money: Varies with scope and scale of effort--see above.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: ECONOMETRIC FORECASTING

Definition/description: Basic concept is that a series of equations is developed to represent the major variables in the economy and the relationships among them and then to solve them simultaneously to obtain a forecast for the key variables, such as GNP and consumer spending.

History/degree of provenness/promise: Wharton School of Business. Brookings Institute.

Promise: Corps districts can subscribe to a forecasting service, such as DRI, to get economic forecasts rather than build their own models. Unless an OCE project, hard to justify.

WHAT DO YOU GET?

Uses and limitations: Major advantage of these models is that they can be used for simulating anticipated or proposed changes in monetary or fiscal policy. Limitations: Complex and expensive. Compared with regression analysis, the extra precision gained rarely compensates for the extra costs incurred by its use.

Form(s) of Output: Quantitative projections, often in extensive tabular form.

Level of Detail: Generally macroeconomics dealing with major accounts, such as income, consumption, and capital spending.

Level of Confidence: High as the extent of change in the overall economy can become the input required to estimate other variables.

Span of Forecast: Most forecasts are for 2-3 years or less, but in theory can be extended indefinitely ahead.

HOW DO YOU DO IT?

Procedures: Yes. Determine the functional form of the equations. Estimate in a simultaneous manner the values of their parameters. Test for the statistical significance of the results and the validity of the assumptions.

WHAT DO YOU NEED?

Data requirements and availability: Detailed data requirements, preferably historical statistics over time (data banks); National data generally more available than international or regional.

People, Including Organizational Back-up: Technical staff backed up by data bank and clerical facilities. Programmer, economists.

Time: Development of model typically takes year or more; most computer runs take less time, sometimes only minutes.

Money: (including facilities): Tends to be costly--for data acquisition, model development, computer time, and technical personnel.

Steiner, 1969, p.440-448

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: DYNAMIC MODELS

Definition/description: A study of the feedback characteristics of activity to show how the parts influence the success of the enterprise. Determines the successive relationships of key factors and formulates mathematical equations to describe them.

History/degree of provenness/promise: Developed by Jay Forrester in the early 1960's. Extremely controversial but seems to have a great degree of promise in forecasting and feedback.

WHAT DO YOU GET?

Uses and limitations: Understand interrelationships among internal activities, as dynamic changes from the environment are experienced. Provides an excellent laboratory for experimenting and predicting what may happen under specific circumstances.
Limitations: Extremely complex. Requires much data, "easily" suboptimized, and often difficult to quantify some variables.

Form(s) of Output: Graphs of changes in a set of variables over time.

Level of Detail: Aggregate.

Level of Confidence: High.
Big Question: Can simulation of really large systems yield sufficient representation to be reliable guides for analysis planning and decision-making.

Span of Forecast: Long-term.

HOW DO YOU DO IT?

Procedures: Yes.

WHAT DO YOU NEED?

Data requirements and availability: Large amounts of input data. Computer programs (Designed for DYNAMO compiler but adapted to more standard systems.)

People, Including Organizational Back-up: Large group of people, including analyst, decision-makers, programmers, economists, etc. Also necessary to have computer facilities.

Time: 6 months to 1 year and up.

Money: Medium to high. Running costs are small, but development costs are high.

Martino 1972, p. 198, 209

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: STRUCTURAL MODELS

Definition/description: "Models that attempt to explain growth in terms of structural variables, but which are not restricted to attempting to justify certain observed behavior."

History/degree of provenness/promise: Model developed by Planning Research Corporation for the Flight Dynamics Laboratory of the U.S. Air Force (Ordered "Techniques for Predicting R&D Costs..." AD 607283). Economic models may be of more interest to Corps.

WHAT DO YOU GET?

Uses and limitations: This specific example refers to forecasting the time and costs required for a given project intended to produce an advance in technology.
Limitations: Errors in determining coefficients (same as econometric models) and same limitations as trend extrapolation: no reason always to expect that the future will continue in the same trends as the past.

Form(s) of Output: Time series of costs and time required to complete development of a specific advance in technology.

Level of Detail: Detailed.

Level of Confidence: Predictive power may be very weak; however, forecaster's degree of confidence can be much higher, since the relationship found is based on more than just coincidence.

Span of Forecast: Determined by technology and need probably less than 20 years.

HOW DO YOU DO IT?

Procedures:

A. Determine necessary set of functions	1. Establish ground rules
Determine costs to be included	2. Determine characteristics
Determine starting & ending times	3. Collect data and review
B. Determine characteristics of technology	4. Set up regression model

WHAT DO YOU NEED?

Data requirements and availability: Consistent historical data necessary (or regression analysis). Need procedures to "standardize data."

People, Including Organizational Back-up: Data analyst. Cost analyst. Mathematician, and programmer. Also computer backup.

Time: Detailed analysis could require a year (guess)

Money: Medium to high.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: DECISION THEORY (see also sheet on DECISION MATRIXES)

Definition/description: Refers to a large, varied, rapidly expanding body of basic and applied theory relating to processes for making a variety of types of decisions under many types and degrees of uncertainty. Stresses rational choices under constraints of psychological, social, political, economic factors, as well as imperfect information.

History/degree of provenness/promise: Decision theory evolved originally out of earlier work in operations research during the World War II period. Decision theory tends to focus on situations whose complexity and uncertainty places them beyond reach of OR. Widely used in defense, high-technology environments.

WHAT DO YOU GET?

Uses and limitations: USES: Steiner suggests that decision theory is used in systems analysis, systems engineering, systems management, and project management. In each of these, decision theory can be applied respectively to forecast requirements, specifications, designs, and execution tasks.

Form(s) of Output: Many and varied, depending on nature, scope, and detail of application. May take the form of a set of linear equations embodying the critical variables, may be realized as an operating computer simulation model, etc.

Level of Detail: Decision theory may be applied at nearly every level of generality or detail, depending on available information, number and variety of tenable assumptions, insights into the pertinent topics, etc.

Level of Confidence: Decision theory is typically invoked where complexity, costs, risks, and potential benefits are large and/or critical. In such situations, heavy reliance may necessarily be placed on the methods used, as decision-makers may have little or no confidence in their own intuitive judgments.

Span of Forecast: From a few months to several years, or even longer in some cases (environmental impacts, for example)

HOW DO YOU DO IT?

Procedures: DECISION MATRIXES (for which see separate sheet) are one simpler, more obvious example. An extensive, rich body of work exists which can be applied according to approaches and problem requirements.

WHAT DO YOU NEED?

Data requirements and availability: Appropriate empirical data pertinent to the problem or situation, plus pertinent models, formulae, etc., for application.

People, Including Organizational Back-up: Decision theory is a sophisticated field emphasizing advanced numerical, statistical and other quantitative techniques. Trained and skilled analysts are required, and the sponsor's sophistication must be commensurate if results are to be comprehensible and useful.

Time: Simple applications might take a few man weeks to a month. Large-scale projects might require a year or more and several man-years.

Money: Varies greatly--see above.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: MORPHOLOGICAL MODELLING

Definition/description: Might also be called structural modelling. A system or technological challenge is broken down into many small component functions or requirements. For each functional requirement, conjecture or brainstorming is employed to generate a number of actual or conceivable solutions. Overall solutions of many sorts are then developed by combining various sub-component solutions.

History/degree of provenness/promise: Morphological modelling was devised and developed in the 1950s and 1960s by the late Fritz Zwicky, who demonstrated its potential especially in the field of aerospace technology. The approach has been widely discussed and experimented with.

WHAT DO YOU GET?

Uses and limitations: USES: Enables users to estimate the range and diversity of future potential solutions for technological challenges, compares and contrasts an extensive list of possibilities which may lead to fruitful R&D. LIMITS: Depends on the analyst's knowledge of the problem, understanding of pertinent technology and powers of conjectural imagination.

Form(s) of Output: Yields morphological diagrams which amount to detailed functional analysis of system or problem requirements, integrated with "maps" of potentially pertinent technology, plus backup documentation often in rich detail.

Level of Detail: Morphological diagrams provides integrative overview of prospects plus organized entry key to pertinent research literature. Amount, richness of detail is limited only by state-of-art of pertinent technologies.

Level of Confidence: Morphological modelling is more an exploration of what could be done than it is a forecast of what will be done.

Span of Forecast: Essentially time-free, in that it looks at functional structures without estimating how much effort for how long may be required to realize a given possibility, although of course this estimate can be made separately.

HOW DO YOU DO IT?

Procedures: 1. Identify/define a system or problem whose future resolution prospects are to be examined. 2. Make an analytic structure which maps the micro-functions entailed. 3. Identify every conceivable technological approach pertinent to each micro-function. 4. Map every plausible combination of approaches which might solve the problem. 5. Select on some basis those approaches which seem most promising.

WHAT DO YOU NEED?

Data requirements and availability: Requires detailed analysis of systems or problems to be studied, comparable descriptions of a wide range of technologies. The availability of these or the feasibility of developing them varies widely from one problem to another.

People, Including Organizational Back-up: An analyst experienced in the method and an analyst richly experienced with pertinent technologies.

Time: For all but the smallest approaches, a re-iterative effort occupying an interval of many weeks or months is necessary for adequate treatment.

Money: Several thousand to tens of thousands of dollars.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: DECISION MATRIXES (MATRICES) (Vertical/horizontal)

Definition/descritption: A basic method in applied decision theory. When two basic kinds of factors (e.g. resources vs requirements) are crucial, a two-dimensional decision table is used. When three kinds of factors are crucial, a three-dimensional cube is employed. A variety of qualitative and quantitative procedures are used to specify each inter-relationship among all the factors considered.

History/degree of provenness/promise: The theory and use of decision matrixes has been developed as an aspect of applied decision theory primarily during the 1960s and 1970s, by DOD, in computer sciences, and in business mgt research. They are widely used.

WHAT DO YOU GET?

Uses and limitations: USES: An explicit, systematic, comprehensive consideration of many interrelationships involved in particular decisions or kinds of decisions. LIMITATIONS: Horizontal matrixes (interaction among factors at one level of generality) are relatively well developed but vertical matrixes are more primitive because it is more difficult to estimate/quantify/specify relationships between different levels of detail.

Form(s) of Output: Matrix/table lists types and examples of factors considered, together with values for each cell, supported by data and estimating procedures used to arrive at values.

Level of Detail: Detail level quite varied. Depending on breadth/precision of decisions analyzed, nature of factors considered, data available, quite detailed matrix sets are feasible.

Level of Confidence: Varies widely, because the method is applicable over a wide range of decisions for which structure/uncertainty may vary widely.

Span of Forecast: Forecasting is only one application of a decision matrix. In that application, the forecast horizon may be "dateless" (decision sequence considered apart from time interval required for each item) or date by cumulative estimate of times required to complete each step in sequence.

HOW DO YOU DO IT?

Procedures: 1. Identify/define decision or type of decision. 2. Identify/define types/particulars of pertinent factors. Array types of factors against each other in a matrix. 3. Select/develop procedures for describing/assessing relationships between each factor and all others. 4. Make overall assessment.

WHAT DO YOU NEED?

Data requirements and availability: Data characterizing/defining each of the factors, specified procedures for manipulating the data. AVAILABILITY: Varies widely, dependent upon nature/explicitness of factor variables.

People, Including Organizational Back-up: Persons experienced in decision matrix techniques, persons experienced/understanding types of decisions to be made for particular purposes.

Time: Varies widely, from a few man-days for simple matrices for which factors are defined/few and data is readily accessible--to many man-months or even man-years for less structured more ambitious problems.

Money: Varies greatly--see above

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: RELEVANCE TREES (Vertical and Horizontal)

Definition/description: A systematic decision-making aid in which weighted indexes based on consensus expert judgment are used to indicate how closely related (relevant) given technological capabilities are to specified needs. Needs may be specified generally (e.g. nationally) or at one or more levels of successive detail, with relevance index numbers assigned at each level.

History/degree of provenness/promise: Minneapolis-Honeywell is the acknowledged developer and user of this approach, using its so-called PATTERN method. Honeywell reports results.

WHAT DO YOU GET?

Uses and limitations: USES: Provides best-judgment rank-order of pertinence for given technological developments, either at various levels of generality (vertical relevance) or across several sectors of activity, such as various military services within Department of Defense (horizontal relevance).

Form(s) of Output: Graphic relevance tree diagram, showing the technological capability analyzed, together with the names of the levels or sectors for which relevance index numbers have been estimated, and the index numbers themselves.

Level of Detail: Actual relevance tree proper shows little detail. However, backup documentation on the basis of which relevance index numbers are assigned may be quite detailed.

Level of Confidence: Varies widely. Can be accepted with much confidence if the technology is sufficiently well identified, potential applications are well identified, and needs priorities for potential applications can be estimated with confidence.

Span of Forecast: Dependent upon the formal forecasting time horizons used by organizations maintaining formal needs assessments programs.

HOW DO YOU DO IT?

Procedures: 1. Identify specific needs. 2. Identify range of potential technological developments which might meet need. 3. Identify/access panel of experts able to judge how well each technology might satisfy each need after proper development. 4. Facilitate consensus of judgment by experts in the form of relevance index numbers for each level or sector of needs/applications analyzed.

WHAT DO YOU NEED?

Data requirements and availability: REQUIREMENTS: Fairly well organized, formalized, and explicit statements of need. Fairly well identified list of prospective technological developments which can be reasonably matched to needs by qualified experts. LIMITS: Designed for DOD environment; requirements may be less available in other settings.

People, Including Organizational Back-up: Requires persons well informed about specific mission needs and about prospective applicable technologies. Implies fairly large, well-organized, sophisticated staffs.

Time: Developed to any minimally useful level, relevance trees require a few months to complete and a minimum of a few man-months of expert talent.

Money: Relatively expensive (minimum tens of thousands of dollars) for any minimally useful output.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: Analysis of Theoretical Limits and Barriers to Technological Advance

Definition/description: A subjective conjectural method mentioned as being of interest in a March/April 1967 issue of Harvard Business Review by James Brian Quinn.

History/degree of provenness/promise: More a mentioned possibility than a systematically developed methodology.

WHAT DO YOU GET?

Uses and limitations: USES: Enables one to conjecture about the future impact of a newly introduced technology. LIMITATIONS: In the absence of clear demand forecasts, conjecture about a new technology's impacts partakes of the flavor of science fiction.

Form(s) of Output: Narrative conjecture or imaginative projection of trends of one form or another.

Level of Detail: Detail may be as rich (and misleading) as the user's imagination permits.

Level of Confidence: Little confidence can be placed in the notion in its current state of non-development. Its utility is more to stimulate the imagination about possibilities than to forecast actual future developments.

Span of Forecast: As far ahead as the user cares to conjecture.

HOW DO YOU DO IT?

Procedures: 1. Identify and describe the new technological innovation. 2. Conjecture about its potential future applications. 3. On the basis of 2), estimate its impact on existing technology, commerce, etc.

WHAT DO YOU NEED?

Data requirements and availability: A newly-made technological innovation and a well-informed, active imagination.

People, Including Organizational Back-up: see above

Time: for serious forecasting purposes, little time or effort can be justified. As an opening sequence prior to serious forecasting, a group might very profitably employ this technique as the basis for one or a few brainstorming sessions.

Money: Very little investment is justified or required.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: ANALYSIS OF INDUSTRIAL BEHAVIOR

Definition/description: Industries classified as either cost-minimizing, sales maximizing, or performance maximizing. For the latter (the science/technology industries), the thesis is applied that the size of the industry's largest plant tends to proceed in stepwise fashion with market growth, other things being equal, and the state of the business cycle permitting. Application of thesis enables predictions about industry behavior/trends.

History/degree of provenness/promise: The industry-typology thesis was advanced by Ayers in 1969, and extended and applied in this case by W.H. Clive Simmons, formerly of Canadian Industries, during the early 70s. These seem to be supported by retrospective data examined by Simmons.

WHAT DO YOU GET?

Uses and limitations: USES: Enables investors, industry suppliers, top managements contemplating plant investment to have some plausible basis for predicting near-term trends within performance maximizing industries. e.g. aerospace, computer, defense, electronics industries. LIMITATIONS: Predictive validity not proven.

Form(s) of Output: Numerical/graphic data which trace past trends in plant size expansion/related impacts, enable projections of future trends.

Level of Detail: Industry-level at best, detail most needed for specific decisions may often be lacking.

Level of Confidence: Limited by virtue of limited experience. Replicable results by critics, successful forecasts made by others with the method may in time increase confidence in the method.

Span of Forecast: Historic data extends backwards over many years. Data may be projected forward as many years as is desired. Presumably, confidence in projections would not extend much beyond average plant lifespan in a given industry.

HOW DO YOU DO IT?

Procedures: 1. Identify and define a specific performance-maximizing industry. 2. Gather and plot history of date-of-opening of industry's largest plants, year by year. 3. Relate plant-opening history to details of past business cycles. 4. Project business cycle for future. 5. Project related plant-opening forecasts by date.

WHAT DO YOU NEED?

Data requirements and availability: Clear, definite data on consistent basis showing history of opening of the largest plants in a clearly defined industry. Raw information is available in most cases, but logical aggregation and interpretation on a coherent basis may be difficult if industry definition is inadequate.

People, Including Organizational Back-up: Business analysts familiar with the industry under study.

Time: Gathering/interpretation of data will require at least a few man-weeks and could require a few man-years if the scale/detail/scope of the analysis is elaborate enough.

$ req: Varies--see above

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: TECHNOLOGICAL AUDIT

Definition/description: A special application of Delphi method, used by Minneapolis-Honeywell as an input to its long-range research planning. A Delphi poll focussed on future technological events having import for Honeywell profits was made among divisional market/engineering people, corporate research scientists, and corporate managers.

History/degree of provenness/promise: Honeywell reports in this application made in 1967-1968 that the four-round poll attained useful clarification and consensus as to Honeywell research priorities, on the basis of predetermined selection criteria.

WHAT DO YOU GET?

Uses and limitations: USES: A selection criterion in allocation of talent and funds for research, plus a technological forecast focussed on company-specific sectors of technology. LIMITATIONS: All the limitations of Delphi: time-consuming, panel makeup may distort results, relies on subjective judgment, etc.

Form(s) of Output: Lists or tables of research priorities associated with panel-weighted judgments which enable rank-ordering of priority selections, within a division or across divisions.

Level of Detail: The immediate detail gained in four rounds was relatively limited. However, since the forecast was conducted among known persons within the company, detail in whatever depth desired was always accessible.

Level of Confidence: Conductors of the effort seem to feel that the results obtained were another useful contribution to research planning, rather than an extension or replacement of methods already in use.

Span of Forecast: Ten years--1967-1977 (Date of forecast span now makes it feasible for Honeywell to check validity of forecast results)

HOW DO YOU DO IT?

Procedures: Four-round Delphi poll (for which see DELPHI sheet), followed up a year later by field interviews in depth with selected panel members.

WHAT DO YOU NEED?

Data requirements and availability: Data and judgments in the possession of accessible and nominally qualified experts. In Honeywell's case, these conditions were satisfied by personnel resources and top-management decision to make the study.

People, Including Organizational Back-up: see above

Time: Source not specific. Initial Delphi probably was made within a single 12-month period. Field interviews were conducted a year later, and may have taken several weeks to a few months.

Money: Company does not report estimated cost, which in any case came out of general management operating budget.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: SOCIAL TREND ANALYSIS

Definition/description: Any of a variety of procedures for identifying, specifying and interpreting continuities, discontinuities, and change rates for any number of specific phenomena related to such matters as health, education, welfare, demography, income, etc.

History/degree of provenness/promise: The effort to collect, standardize, and update statistical and other data about societal trends is at least 200 years old, and was in fact the origin of interest in statistics. Analyses accepted as valid are restricted rather narrowly, with population trends perhaps most generally regarded as validly analyzable.

WHAT DO YOU GET?

Uses and limitations: USES: Systematic insights into given trends or into interrelationships among trends may yield useful forewarnings of emergent problems and developing opportunities, from the perspective of any given organization. LIMITATIONS: Serious data problems (see below), plus weak or non-existent theories about processes of social change.

Form(s) of Output: Typically, selected time series data in graphic profile form, accompanied by analytic/interpretative narratives. The Office of Management and Budget publication, SOCIAL INDICATORS (1973) is the current standard source.

Level of Detail: Usually gross and general relative to the phenomenon of interest. Development of detail is sometimes possible, but usually only at great expense and rapidly declining confidence as detail increases.

Level of Confidence: At best, confidence is quite high. EXAMPLE: Work force projections for given future years, based on present population plus current birth rates. At worst, no confidence at all. EXAMPLE: Status of organized religions 15 years hence.

Span of Forecast: Can be any time span. For many phenomena there is an apparent or presumed time cycle which imposes a natural forecast span. EXAMPLE: Average lifespan determines a natural span for forecasting age-cohort shifts.

HOW DO YOU DO IT?

Procedures: 1. Identify intended uses of analysis. 2. Identify/define social trends of interest. 3. Identify/compile/assess pertinent time-series data, other information. 4. Integrate/correlate pertinent sets of time-series data. 5. Interpret relation of time-series data trends to social trends of interest.

WHAT DO YOU NEED?

Data requirements and availability: REQUIREMENTS: Standardized multi-year time series data which demonstrably or at least plausibly reflects--hopefully anticipates--significant changes in direction or rate of development of societal trends of interest. AVAILABILITY: Very poor. Most existing data represents INPUT measures while most significant measures are OUTPUT measures. EXAMPLE: It's not what is spent on education which determines changes in quality or attainment levels in education.

People, Including Organizational Back-up: Qualified social scientists experienced in phenomena of interests and in development and use of statistical time-series measurements.

Time: If existing indicators are available and acceptable, preliminary interpretations for given purposes may require only a few days. At the other extreme, many man-months or even man-years may be required.

Money: Varies greatly--see above.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: SCENARIO-WRITING

Definition/description: Literary, numerical, and/or graphic narratives which describe and/or explore the implications of future sequences of events and states of affairs, given some specified topic and some set of explicit or implicit premises.

History/degree of provenness/promise: In literary form this represents one of the oldest, most widely practiced methods of conjecturing about possible futures, including utopian literature, science fiction, etc. The approach is more useful for interpreting forecasts or stimulating the imagination than it is for making firm, rigorous forecasts.

WHAT DO YOU GET?

Uses and limitations: USES: Excellent for integrating a number of isolated and diverse specific projections and/or predictions, so that the user acquires a "feel" for the overall future state address by each isolated projection. LIMITATIONS: Much is implicit, ambiguous, and not necessarily supported by specific, reliable, valid forecasts.

Form(s) of Output: Narratives, graphs, illustrations, films, interactive computer displays, other.

Level of Detail: Depends on intended users and intended objectives. May be limited to particular details available from individual forecasts, or may incorporate inferential higher-order relationships in order to integrate isolated predictions into a coherent "story." Much usually is plausible but not necessarily predicted.

Level of Confidence: Depends on scope, nature of topic. Where the scenario represents a plan believed to be well within the capacity of the scenario-writing organization, much confidence may be placed in it.

Span of Forecast: Unlimited range, subject to users requirement for detail, validity, etc.

HOW DO YOU DO IT?

Procedures: 1. Specific topic of scenario in some detail. 2. Identify and reconcile a set of explicit premises on which to base the scenario. 3. In one or more subjective drafts reviewed by critics including users, develop/extend/refine scenario.

WHAT DO YOU NEED?

Data requirements and availability: REQUIREMENTS: Clear sense of who the user is, what the topic is, and intended uses of the scenario. Large fund of data, information, ideas pertinent to the topic. Persons skilled in scenario development working in concert with persons expert in the subject matter. AVAILABILITY: Depends on topic, user needs.

People, Including Organizational Back-up: Requires people able to devise relatively smooth and plausible accounts in rich detail dependent upon scattered, disparate, discontinuous individual forecasts. User must have sure sense of requirements, willingness/ability to offer constructive criticism as drafting proceeds.

Time: If user needs and raw information are available, first draft scenario can be done in a few days or weeks by experienced persons. Effort may require much longer.

Money: Requires a few man-weeks to a few man-years, and typically a few man-months if a SET of scenarios exploring given topics on the basis of alternative sets of premises is required, as is often necessary for optimum utility.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: CANONICAL TREND VARIATION (see also SURPRISE-FREE PROJECTIONS)

Definition/description: A set of surprise-free projections is used to develop an arbitrary, contrastive set of "standard worlds," or different potential futures for a given topic. By altering basic assumptions for one or more projections (e.g. assumptions about future birth rates), one develops correspondingly different "standard worlds". Alteration of assumptions with corresponding outputs are called canonical trend variations.

History/degree of provenness/promise: Kahn-Weiner developed this method as published in their book THE YEAR 2000 in 1967. Their concept is often cited and sometimes applied by others.

WHAT DO YOU GET?

Uses and limitations: USES: Provides an explicit, systematic set of contrastive "standard worlds" exploring a set of variable potential futures for the topic. LIMITATIONS: Canonical Trend Variations, like surprise-free projections, are NOT predictions or forecasts, merely useful tools for intelligent conjecture.

Form(s) of Output: Graphic, numerical, or verbal characterizations of different potential "standard worlds" for a given topic.

Level of Detail: Initial Canonical Trend Variations are typically gross and simple. Detail can be added progressively as new information is discovered or incorporated, and as specific issues requiring study arise.

Level of Confidence: Confidence levels do not pertain, because Canonical Trend Variations as such are NOT regarded as predictions or forecasts.

Span of Forecast: Any time-span desired.

HOW DO YOU DO IT?

Procedures: 1. Select a set of surprise-free projections pertinent to topic. 2. Acquire data information describing the pertinent projections. 3. One by one, vary the sets of assumptions made about future rates of change/stability in the trends. 3. Develop individual canonical trend variation using each of the different sets of assumptions with the same trend data.

WHAT DO YOU NEED?

Data requirements and availability: One needs an adequate topic definition, identification of topic-pertinent trends, data which describe the trends. Availability depends on the nature of the topic and the amount of detail sought.

People, Including Organizational Back-up: Analysts must be experienced with respect to topic, know and have access to appropriate data sources, be able to judge and state critical assumptions, be able to systematically vary stated assumptions, and to manipulate data/information accordingly.

Time: Varies greatly, depending on scope, nature of topic, amount of information included in base. Can be one man-day to one or more man-months.

Money: Varies greatly--see above.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: SURPRISE-FREE PROJECTIONS (see also Canonical Trend Variation)

Definition/description: Kahn-Weiner, the devisers of this method, state: "One can think of a surprise-free projection as being as sophisticated a projection as it seems reasonable to make given the available understanding of current trends...there is no implication that a surprise-free projection is likely."

History/degree of provenness/promise: In a general sense, demographers, economists, and many other professionals have long made use of projections of the present into the future IF PRESENT TRENDS PERSIST. Such projections--which to repeat are NOT forecasts--serve as a useful comparison standard for actual predictions.

WHAT DO YOU GET?

Uses and limitations: USES: Projects a "standard" and/or "surprise-free" future which serves as a reference for investigating the timing and impacts of any one or more "surprises" one might conceive of pertinent to his forecast topic. LIMITATIONS: Arbitrary selection of trends judged pertinent to topic. Sometimes, data may be unavailable or of suspicious quality.

Form(s) of Output: Many examples are seen in Kahn-Weiner's The Year 2000, consisting of linear projections, tables of data, and contrastive lists of bi-modal trends.

Level of Detail: Depends on the level-of-detail of data used, plus the nature of the topic. Kahn-Weiner, for example, project "worlds" which means a very gross level of detail. If one projected "surprise-free" budgets for the Corps, much more detail could be provided.

Level of Confidence: Since surprise-free projections are not intended to be accepted as forecasts in and of themselves, confidence levels do not pertain.

Span of Forecast: May be whatever time-span the analyst selects.

HOW DO YOU DO IT?

Procedures: 1. Specify the projection topic carefully. 2. Assemble time-series and/or other data to be used. 3. Develop explicit assumptions about projected rates of change in each trend considered. 4. Apply assumed change-rates to data base, projecting it over the future time-horizon selected.

WHAT DO YOU NEED?

Data requirements and availability: Because the method can be used for nearly any topic, data requirements and availability vary greatly. At some level of detail and precision, some sort of data or other information which can be used for surprise-free projection is almost always available.

People, Including Organizational Back-up: Analysts must be experienced with respect to projection topic, know and have access to appropriate data sources, understand and be able to use basic tools of numerical projection. If "soft" information is used, explicit use of subjective judgment is important.

Time: Varies greatly, depending on scope, nature of topic, amount of information included in base. Can be one man-day to one or more man-months.

Money: Varies greatly--see above.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: SOCIAL INDICATORS

Definition/description: Social indicators are statistical-trend-line descriptions of change in social phenomena. They cover a wide range of phenomena, from population changes, shifts in levels of educational attainment, crime rates, shifts in political sentiments, to religious activity, and many more.
History/degree of provenness/promise: Modelled on the successful earlier development of economic indicators. Most work has been done since 1960. Still in the research/demonstration/experimental stage.

WHAT DO YOU GET?

Uses and limitations: USES: Diagnosis of social ills, priority-setting for social service program development and delivery planning, predicting important aspects of future states of society. LIMITATIONS: Not well-developed or accepted, causal linkages between indicators and phenomena not often clear or well-grounded.

Form(s) of Output: Time-series data in graphic form, usually accompanied by interpretative narratives.

Level of Detail: Since social indicator time-series are usually based on operational data (birth records, hospital reports, crime reports, etc.), level of detail varies as widely as scope of source documents.

Level of Confidence: Very low. Input measures often necessarily used as output measures. Example: Amount of funds spent on education or number of years spent in school are taken to represent levels of educational quality or attainment.

Span of Forecast: Most social indicators work to date has emphasized development of indexes based on historical and current data. Development of LEADING (futures) indicators is still in primitive state.

HOW DO YOU DO IT?

Procedures: 1. Identify social phenomenon of interest. 2. Search for or try to develop statistical time-series data which can be taken to reflect changes in the phenomena of interest. 3. Assemble/compile data. 4. Refine/extend/attempt to validate the data.

WHAT DO YOU NEED?

Data requirements and availability: REQUIREMENTS: Time-series data on a uniform basis which can be accepted as reflecting changes in the social phenomenon of interest. AVAILABILITY: A great deal of apparently relevant data is available from many sources. CREDIBLE or VALID data is difficult to find or to develop.

People, Including Organizational Back-up: Persons experienced in theories of social change and/or persons competent in statistical methodologies.

Time: To date, social indicators is in the research stage. Individual projects may take as little as 30-60 days. Principal projects have been ongoing for several years.

Money: As little as one man-month to many man-years, with corresponding cost variations.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: LEADING INDICATOR (ECONOMIC)

Definition/description: Any measure of the economy that moves in the same manner as the economy but does so several months ahead of the economy.

History/degree of provenness/promise: Intensively developed by economists in the period following World War II, as an aspect of business cycle theory. Leading, concurrent, and lagging indicators are widely used by economists, businessmen, financiers, and government to assess economic performance.

WHAT DO YOU GET?

Uses and limitations: Useful in forecasting or planning budget levels, sales, profits, inflation, tax rates, and many other aspects of the economy. Primary limits are two: 1)Based on past trends and therefore may fail to predict basic changes, such as current "stagflation", 2)Requires time series data on a standard base over a period of many years, which is not always available.

Form(s) of Output: Linear graphs, numerical tables/matrices.

Level of Detail: Indicators in most general use are at the national economy level. Some regional indicators are also available, as are industry-level indicators at the national and regional levels.

Level of Confidence: Widely accepted and used as perhaps one of the most reliable clues to the future performance of the economy.

Span of Forecast: Heavily emphasizes the next quarter and the next year. Some work has been done on longer time-spans.

HOW DO YOU DO IT?

Procedures: Many indicators are generally accessible from the National Bureau of Economic Research, Bureau of the Census, Bureau of Labor Statistics, Federal Reserve Board, etc. To construct a leading indicator, one must find a trend in which changes precede changes in a trend of interest, collect time-series data, standardize the data, and graph the trends.

WHAT DO YOU NEED?

Data requirements and availability: As noted above, many well-established leading indicators are published regularly by government agencies and other sources.

People, Including Organizational Back-up: Analysis of existing leading indicators requires appropriately experienced economists and others familiar with the details and problems of whichever economic variables are being tracked.

Time: 1. Interpretation of indicators maintained and published by others can require modest amounts of time (few hours per month) or much greater time for special studies. 2. Index construction may require several man-years of effort.

Money: Nominal to modest cost to access and interpret existing indicators. Index construction and validation may cost tens of thousands of dollars, or more.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: CHANGE SIGNALS MONITORING

Definition/description: A systematic, four-step procedure proposed by James Bright. It involves: 1)Monitor environment for precursor signals (see PRECURSOR EVENTS, separate entry); 2)Identify alternative consequences if signaled changes are valid and persist; 3)Select items to monitor continuously 4)Organize present results of monitoring to management.

History/degree of provenness/promise: Bright first proposed the explicit procedure in a 1970 article in HARVARD BUSINESS REVIEW. He points out, however, that a less formal version of his procedure has long been common practice in business.

WHAT DO YOU GET?

Uses and limitations: USES: Basis for organizing information and intelligence system, focussing attention on key events/trends. LIMITATIONS: Requires model or theory which relates precursor signals to changes of interest; signals may be obscure or difficult to interpret.

Form(s) of Output: May be numerical tables, graphic data, narratives.

Level of Detail: Variable depending on nature and number of signals monitored, effort expended to interpret signals.

Level of Confidence: Limited. Main utility is as a preliminary screening indicator, attention focusser.

Span of Forecast: Varies, dependent upon assumed or estimated time-lag between the precursor signal and the change foreseen.

HOW DO YOU DO IT?

Procedures: 1. Identify change(s) of interest. 2. Identify precursory signals presumed to foreshadow the change. 3. Organize/maintain system for identifying and monitoring change signals. 4. Organize method for regularly and systematically reporting results of monitoring to pertinent decision-makers.

WHAT DO YOU NEED?

Data requirements and availability: List of important changes to be followed, information base, procedures for organizing/monitoring information base.

People, Including Organizational Back-up: Analysts knowledgeable about changes of interest, experienced in development and maintainance of monitoring systems.

Time: Initial readouts from system will require at least a few weeks in simplest systems; a year or more may be required for useful outputs from more ambitious systems. Thereafter, system may be tapped continuously at any time.

Money: Nominal for simple systems, hundreds to thousands of dollars to develop and/or maintain, depending on size and complexity of system.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: CRITICAL FACTORS ANALYSIS

Definition/description: A specific consensus-judgment method devised by George Steiner. May also refer more broadly to a step in systems analysis or in the CRITICAL PATH METHOD (for which see separate entry).

History/degree of provenness/promise: In the mid 60s, Steiner identified 71 strategic factors thought to be of critical importance in the success of an enterprise. He made a worldwide survey of business executives in which they selected 60 factors as being of average or greater importance.

WHAT DO YOU GET?

Uses and limitations: USES: In any situation or mission which can be reasonably well delimited and for which experienced participants can be identified, method enables a consensus judgment on which issues or problems are and/or will be in future most important for success. LIMITATIONS: Depends on subjective judgments, selection of judges may be difficult, severe disagreements may be difficult to reconcile.

Form(s) of Output: Descriptive listing of pertinent factors, together with tabulation of ranking scores judging importance.

Level of Detail: Because the persons whose judgment is sought are experienced with respect to the forecast topic, explicit detail is usually limited.

Level of Confidence: Because this is a qualitative, subjective-judgment method, level of confidence depends on users' assessment of judges' competence.

Span of Forecast: In Steiner's study, the time-span was "timeless"; that is, he looked for factors which will ALWAYS be critical to success. For a specific mission, the time-span is set by the estimated time required to complete mission.

HOW DO YOU DO IT?

Procedures: 1. Identify the forecast topic. 2. From literature, other sources prepare draft list of critical factors. 3. From literature or other sources, identify/obtain-participation of experienced judges. 4. Ask each judge to rank-order factors by order of importance. 5. Tabulate returns, rank-order factors by importance according to overall ratings assigned by judges.

WHAT DO YOU NEED?

Data requirements and availability: REQUIREMENT: Knowledge of the topic, access to/cooperation of qualified judges. AVAILABILITY: Where topic is broad or vague, knowledge and identification of competent judges may be difficult.

People, Including Organizational Back-up: A project leader skilled in survey research techniques, and a roster of qualified judges willing to participate in the survey.

Time: Only a few weeks (at best, even days) may be required if the judges are few and physically accessible in one area. More ambitious surveys may require several months or a year.

Money: Varies widely with scope of project--see above.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: ESTIMATES OF PREFERENCES

Definition/description: Refers to any of a wide variety of procedures employed to rank-order a specified set of options/choices within a population viewed as critical to the acceptance/rejection of one or more of the specified options/choices.

History/degree of provenness/promise: Perhaps elections are among the oldest examples. In elections, qualified voters express their preferences among candidate leaders for a specified future period. The most rigorous and elaborate methods are those used in market research and in survey (opinion) research.

WHAT DO YOU GET?

Uses and limitations: USES: Permits users to evaluate the ease/difficulty of "selling" a given option to a given population. LIMITATIONS: Yields statistical results, thus embodies the problems of sample size/representativeness, time-money costs, missing rapidly shifting preferences, etc.

Form(s) of Output: A set of weighted, intercorrelated statistics together with an explanation and interpretation of the purported significance of the statistics.

Level of Detail: Depending on the topic and the amount of resources invested, this method may yield any level of detail desired, although it may often be difficult to decide when the detail-level is specious rather than actual.

Level of Confidence: Where the topic and procedures have been widely used--as in market research and opinion research--much confidence can be placed in these methods. In other applications, level of confidence earned varies widely.

Span of Forecast: In theory any time-span might be employed. In practice, it is assumed that preference shift markedly over a period of at least a few weeks and at most a very few years.

HOW DO YOU DO IT?

Procedures: 1. Specify the topic. 2. Specify the options to be assessed. 3. Devise specific survey instruments/procedures. 4. Train or retain personnel experienced in these methodologies. 5. Pre-test instrument. 6. Conduct one or more rounds of survey from a specified sample of a specified population. 6. Assess results.

WHAT DO YOU NEED?

Data requirements and availability: Most data required concerns the definition and characteristics of the population to be sampled. In applications where this method has been widely used for a long time, extensive, reliable data is accessible. In other cases, requirements/availability vary greatly.

People, Including Organizational Back-up: Requires a group experienced in these methods, plus substantial resources to survey the sample, process data, interpret results.

Time: Most applications require at least a few weeks for results, while many require a year or even longer.

Money: Not inexpensive. At least a few hundred dollars and up to many thousands of dollars would be the typical range.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: SUBJECTIVE ESTIMATES OF PROBABILITY

Definition/description: Refers to a wide, diverse range of procedures--implicit/explicit, informal/formal, organized/unorganized--primarily dependent on intuitive estimates not well-documented--or even documentable--by valid, reliable data. Delphi methods, opinion polls, "seat-of-the-pants" estimates, are a few examples.

History/degree of provenness/promise: As old as humanity. Every personal or collective action or behavior is based on some set of intents, goals, and objectives which can be realized only in future--the next minute, tomorrow, next year, etc. Many actions--perhaps most--are taken when the attainability and impact of intended outcomes is unknown, or even unknowable.

WHAT DO YOU GET?

Uses and limitations: USES: Widely used when the impact of uncertainty is considered insignificant or unmanageable. LIMITATIONS: Much recent work in psychology suggests that there are severe, characteristic constraints on subjective probability estimates, especially in complex, rapidly changing environment.

Form(s) of Output: Often implicit in decisions or action t ken. Often only alluded to or unconsciously expressed by the estimator. At the most elaborate end of the spectrum, multi-round pools with feedback and statistical analysis may be employed, as in the Delphi method.

Level of Detail: As variable as the endless number of situations in which intuitive judgment is relied upon.

Level of Confidence: Because the method is subjective, so is the level of confidence assigned by the user of the method, or by the recipient of the user's results. If you respect the person's judgment and consider his experience appropriate, you tend to have confidence in his estimates.

Span of Forecast: May often be unstated, or can be any time interval the estimator feels competent to foresee.

HOW DO YOU DO IT?

Procedures: 1. Identify the topic. 2. Select the person(s) whose estimate is to be accepted. 3. If applicable, specify procedures to be followed in making the estimate. 4. Apply procedures. 5. Assess the resulting estimates.

WHAT DO YOU NEED?

Data requirements and availability: Varies greatly. No explicit data may be required in the most informal case, while vast reams of data with analysis of estimation procedures and results may be invoked in the most elaborate case.

People, Including Organizational Back-up: Varies from one person whose estimates are to be accepted to in-house or retained survey research organizations.

Time: Ten minutes to one-man-year or even longer. (Yankelovich, Gallup, and others offer services on a continuous basis)

Money: Varies widely--see above.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: PREDICTION OF CHANGE-OVER POINTS (see also ENVELOPE CURVES)

Definition/description: Innovations (especially technological) are often found to emulate in such a way that improvements immediately after invention are rapid, then slower until most of that invention's contribution to improvement has been realized. As a curve, this is the familiar S-shaped or growth curve. Often, when one curve has been "saturated" a new innovation with a new curve appears. A so-called ENVELOPE curve can be drawn which encloses successive growth curves. A CHANGE-OVER point is that point along an envelope curve at which one growth curve is succeeded by another.

History/degree of provenness/promise: BIOLOGICAL growth curves have been well-established for several decades. Within the past 20-30 years, it has been generally accepted (by general systems theorists and others) that many non-biological phenomena replicate growth-curve evolution. Many attempts have been made to give specific applications of this analogy, but are not entirely convincing.

WHAT DO YOU GET?

Uses and limitations: USES: Taken with other indicators, can yield better-than-random timing estimates as to when new innovations may be expected in a given field. LIMITATIONS: There is no adequate theory to explain the structure, dynamics, and scheduling of, say, technological advances which satisfactorily equates it with comparable models explaining biological growth.

Form(s) of Output: Given a series of growth curves within an envelope curve, change-over points are indicated and located either by some specified functional-attainment date or by estimated calendar date.

Level of Detail: Growth curves typically describe a single parameter in graphic-numeric profiles.

Level of Confidence: Limited, since there is no basic theory, and especially no theory which suggests how to identify where along a given growth curve a given phenomena is now located.

Span of Forecast: Tends to range from two-three years to 15-20 years.

HOW DO YOU DO IT?

Procedures: 1. Identify the performance or other phenomenon of interest. 2. Identify the functional parameter(s) which describe improvements in that performance. 3. For each parameter, plot its past record, usually in terms of date a given new peak value is attained. 4. Project parameter to saturation. 5.On basis of projection, infer when a new growth curve should be expected to "take over" improvement.

WHAT DO YOU NEED?

Data requirements and availability: Requires data of past peak-value attainment for parameters of interest. These are often available in unambiguous form for technological advances, much less often for other forms of change, especially social change.

People, Including Organizational Back-up: An analyst who is experienced with the technology in question, including future candidate technologies, and who understands numerical projection methods.

Time: If data is at hand and performance parameters of interest are known, a few days may provide preliminary predictions. If assumptions and data must be developed, refined, and agreed upon, several man-months over two years or more may be required.

Money: Varies greatly--see above.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: AMPLITUDE-ADJUSTED INDEX

Definition/description: A composite index of several economic indicators whose interval-to-interval variations vary a great deal. EXAMPLE: New order indicators may vary a great deal from week to week, while the average workweek varies only slightly from year to year. The individual indicators are adjusted so that each varies about its own average, making the individual indicators more comparable.

History/degree of provenness/promise: The use of composite indexes has developed in the general environment of economic research and practice since the 1950s. Like all economic indexes, composite indexes are seen as intermediary between purely intuitive judgments and rigorous theory, thus requiring careful interpretation.

WHAT DO YOU GET?

Uses and limitations: USES: For forecasting purposes, one can fashion composite indexes out of a set of LEADING economic indicators (see entry on ECONOMIC INDICATORS). LIMITATIONS: Where leading indicators of interest are few, unreliable, or unusually diverse, interpretation of the composite index may be difficult or unreliable.

Form(s) of Output: Tabular or graphic plots showing the variations of the individual indexes about their respective means, and/or the variation of the composite index number about its mean.

Level of Detail: Economic indexes by design are general, abstract, lacking in specific detail, and may omit, mask, or under-represent significant particulars.

Level of Confidence: Depends essentially on the competence of the economists constructing the index and on the confidence placed in them by users. The National Bureau of Economic Research is the most respected source in the field.

Span of Forecast: Economic indicators generally are dependent on business cycle analysis, which typically deals in periods of a few months to a few years--say quarterly to biannual intervals.

HOW DO YOU DO IT?

Procedures: 1. Identify economic phenomenon of interest. 2. Identify/select leading indicators which pertain. 3. Compute the mean and mean variation for each indicator for some past period. 4. Combine the mean variations for all indicators into a composite variation value, and plot it. 5. Drawing on business cycle theory, estimate the future timing and degree of impact on the phenomenon of interest.

WHAT DO YOU NEED?

Data requirements and availability: REQUIREMENTS: A set of pertinent leading indicators or the means to construct same. AVAILABILITY: Those in general use are readily available from federal and other sources.

People, Including Organizational Back-up: Economists trained and experienced in the construction and/or interpretation of composite indexes are required.

Time: Interpretation of published composite leading-indicator indexes may require only a few hours or days. Construction of special-purpose indexes may require a few weeks or months and several man-weeks to man-months of effort.

Money: Depends on effort level required--see above.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: DIFFUSION INDEX

Definition/description: A measure of the extent to which a set of indicators related to given economic phenomena are varying together and in the same direction. EXAMPLE: Inflation trends can be assessed by price indexes, productivity indexes, and supply/demand indexes. A Diffusion Index would show whether all are rising, all falling, or some combination.

History/degree of provenness/promise: Developed largely by Geoffrey H. Moore and the National Bureau of Economic Research during the 1960s. NBER is the single most distinguished and influential economic research organization in the U.S. A systematic but subjective judgmental estimate about the rate and direction of change in some economic phenomenon.

WHAT DO YOU GET?

Uses and limitations: USES: Good for a preliminary quick look at some economic phenomenon to see if there is any evidence that a conjectured change may be occurring. LIMITATIONS: Ultimately depends upon experienced but subjective best judgment.

Form(s) of Output: An array of the current readings of the indicators which are judged pertinent to the phenomenon, plus an oral or written narrative given the expert's estimated interpretation of the direction and rate of change indicated in the associated economic phenomenon.

Level of Detail: Very general, abstract, but varies with the number of indicators which can plausibly be associated with the economic phenomenon studied.

Level of Confidence: Because it is a subjective judgment approach, the level of confidence is determined by the degree of confidence imputed to the expert consulted, on the basis of his professional experience and performance.

Span of Forecast: The diffusion index is based upon business cycle indicators, which typically look only a few months or at best 2-3 years ahead.

HOW DO YOU DO IT?

Procedures: 1. Specify the economic phenomenon of interest. 2. Decide on and assemble economic indicators held to be associated with it. 3. For each indicator, assess the direction and rate of recent changes in that indicator. 4. Estimate the overall rate and direction of change implied by the indicator set. 5. Report and interpret the estimate made in 4.

WHAT DO YOU NEED?

Data requirements and availability: Requires access to pertinent economic indicators, usually a routine matter as such data is widely published. Getting current indicator data can be a problem if the phenomenon of interest is thought to be changing rapidly, since indicators tend to be published at quarterly/annual intervals.

People, Including Organizational Back-up: An economist trained and experienced in the construction and interpretation of diffusion indexes.

Time: In simple cases, a few days. Where more than one opinion is needed or many indicators must be assembled and examined a few weeks or even a few months might be required. The easier, shorter time frame is perhaps more typical.

Money: Depends on the compensation rate of the one or a few professional economists employed--a few hundred to a few thousand dollars.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: AUTHORITY or "GENIUS" FORECASTING

Definition/description: These are forecasts made by individuals thought to be authorities in the field. Such forecasts range from off-hand judgmental conclusions to carefully documented and weighed analyses.

History/degree of provenness/promise: An old and common (perhaps the commonest) forecasting technique. Certainly the value of informed judgment is well established. It is also well established that even the best informed can be very wrong.

WHAT DO YOU GET?

Uses and limitations: An especially good way to obtain a quick idea of expert opinion in an area. Limitations include prospects of over-reliance on "the" expert; bandwagon effects; and the ever-present possibility of the authority being out of date, close-minded, or interested less in his forecast than in his fee and reputation.

Form(s) of Output: No set form.

Level of Detail: Range from great detail to global generality.

Level of Confidence: Often very high, especially if the genius forecast is confirmed by independent cross-checks. A real problem is that the level of confidence is sometimes unrealistically high.

Span of Forecast: Can cover any span.

HOW DO YOU DO IT?

Procedures: Usual pattern is to pose the question to the authority and let him respond in any way he wishes to.

WHAT DO YOU NEED?

Data requirements and availability: These are the responsibility of the genius.

People, Including Organizational Back-up: All that is needed is the genius.

Time: Great range.

Money: Great range.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: SURVEYS OF INTENTIONS OR ATTITUDES

Definition/description: Surveys of this type consist of asking people their plans for the future or their feelings about items. The standard public opinion poll is the best known example of this technique. Scope can be broad or limited. Such surveys are to be distinguished from surveys to get data on activities or units.

History/degree of provenness/promise: Well-known surveys of this sort include McGraw-Hill, Commerce-SEC, and Fortune surveys of business plans; several surveys of consumer buying plans; studies of values and attitudes of people made by Yankelovich, Potomac Association and Survey Research Center.

WHAT DO YOU GET?

Uses and limitations: Product is statements of expectations or viewpoints. This is the chief way to get systematic data on plans and priorities of institutions and individuals. Technique does not work for unplanned (impulse) decisions.

Form(s) of Output: Answers to specific questions.

Level of Detail: Entirely flexible--from global to finest grain.

Level of Confidence: Confidence level is seldom high for consumer purchasing intentions and declines with specificity of product and remoteness of planned action. Probability techniques improve reliability. Attitude data are subject to semantic uncertainties. Both types of results are much influenced by unexpected events.

Span of Forecast: Most survey of plans focus on quarterly and annual end-points.

HOW DO YOU DO IT?

Procedures: (1) Identify the data to be collected, (2) develop questionnaire, (3) select representative sample, (4) conduct survey and record results, (5) interpret findings. Mail, telephone, and in-person surveys are common.

WHAT DO YOU NEED?

Data requirements and availability: Often difficult to elicit clean responses to planned actions or complex attitudinal issues.

People, Including Organizational Back-up: Expertise is required on study design, questionnaire development, telephone or in-person interviewing, statistical analysis of results. Computer facilities often required for analysis of findings.

Time: Minimum of a month or two; major surveys require six or more months.

Money: Small mail surveys might be done for a few thousand dollars; complex in-person studies cost hundreds of thousands of dollars, much of it in generating and pretesting questionnaires.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: SURVEYS OF ACTIVITIES OR UNITS

Definition/description: Surveys of activities or units consist of asking people specific questions concerning past events. Survey can be national or less in scope and can cover broad or specific areas. These surveys are to be distinguished from surveys of intentions or attitudes.

History/degree of provenness/promise: Among the best known surveys of this type are the various census studies, Commerce-SEC surveys of current business, and a numerous data collecting efforts on behalf of special interests. Data surveys underlie the large majority of forecasts.

WHAT DO YOU GET?

Uses and limitations: The product is historical data essential as the basis for projections. Surveys can be made on almost any subject. Limitations depend on the nature and source of the series.

From(s) of Output: Replies to specific questions. Repeat surveys are often presented in time-series tables or charts.

Level of Detail: Level of detail can be very fine-grained or global.

Level of Confidence: For established surveys, such as the Census and some major sales surveys, the level of confidence is very high. Surveys employing an adequate sample are not reliable.

Span of Forecast: These kinds of surveys provide the basis for forecasts but are not in themselves forecasts.

HOW DO YOU DO IT?

Procedures: (1) Identify data to be collected, (2) develop questionnaire, (3) select representative sample, (4) conduct survey and record responses, (5) interpret findings. Mail, telephone, and in-person surveys are common.

WHAT DO YOU NEED?

Data requirements and availability: In some circumstances steps (1),(3) and (5) present difficulties, but in most cases survey work is straightforward.

People, Including Organizational Back-up: Survey and questionnaire design are specialty fields; extensive field work requires trained personnel; data often must be analyzed via computer facilities backed by statistical know-how.

Time: Appreciable surveys require a matter of months in preparation, conduct, and analysis.

Money: A typical 10-item mail survey of 1000 respondents would usually cost between $2000 and $5000; in-depth survey of the same items utilizing trained interviewers would cost $10,000 to $25,000 and up.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: PANELS

Definition/description: In this technique experts are brought together in open discussion to reach a consensus judgment concerning the future of a specified trend or prospect. Delphi is a special case of the use of panels for forecasting.

History/degree of provenness/promise: One of the oldest of all forecasting techniques. Classic examples of this technique include Project Forecast of the Air Force and Project Seabed of the Navy.

WHAT DO YOU GET?

Uses and limitations: Panel forecasting is suitable (but not necessarily best) whenever expert opinion is the major input. The method is fast, straightforward, and easy to conduct. Limitations include the danger of generating a "band-wagon" majority opinion. In addition, specialists are often unwilling to abandon in public previously expressed opinions.

Form(s) of Output: Usually in narrative form, backed by whatever data the panel used in support of conclusions.

Level of Detail: Technique can be used for all levels of detail, but appears to be used chiefly with problems of intermediate or grosser detail.

Level of Confidence: Very difficult to assess. Depends on insight of panel, nature of topic being forecast, and complexity of forces affecting the forecast.

Span of Forecast: No limitations.

HOW DO YOU DO IT?

Procedures: Simple open discussion by panel members, with or without structure.

WHAT DO YOU NEED?

Data requirements and availability: Usually panel's knowledge provides the necessary data.

People, Including Organizational Back-up: Panel plus recorder and summarizer.

Time: Can range from an hour to several days or more.

Money: Costs are minimal for informal panels but can be considerable for extended conferences of high-fee panelists.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: DELPHI

Definition/description: This technique employs a panel of experts to render judgments as to timing, probability, and often implications of specified trends and events. The technique differs from the usual panel discussion in maintaining anonymity of panel members, iteration of results with controlled feedback, and statistical group response.

History/degree of provenness/promise: The technique was developed in the early 1960s at RAND. Some 4000 Delphis are said to have been done. A popular forecasting technique, there are many variations of the classic method.

WHAT DO YOU GET?

Uses and limitations: Delphi is used where qualitative judgment is the main input. The method is adaptable to almost any subject matter. It is helpful in bringing together a wide spectrum of expertise and in exposing related factors or linkages. Limitations are in reliability of judgment and in the usual practice of reporting only majority viewpoints.

Form(s) of Output: Concise statements of timing, probability, and likely impacts of specified trends of developments. Often presented in tables or curves.

Level of Detail: Method can deal with any level of detail, but most Delphis treat issues of medium or larger scale.

Level of Confidence: Not established and perhaps unestablishable. In general, however, forecasts are considered markedly better than those available from panels of non-experts, and probably better than those by single-person forecasts.

Span of Forecasts: Typical range is 10-50 years, but can be for any period.

HOW DO YOU DO IT?

Procedures: A panel of experts is asked to give their judgment on the future of specified trends or events. Responses are summarized and returned to panel for re-assessment of previous judgments. Usuallly three iterations are involved. Anonymity of panel reduces bandwagon effects.

WHAT DO YOU NEED?

Data requirements and availability: (1) Knowledge of who is "expert"; (2) explicit definitions of topics to be forecast; (3) directions on what is to be rated and how described.

People, Including Organizational Back-up: Some familiarity with method is required of Delphi leader. Considerable editorial and clerical back-up is required.

Time: Minimum time for usual mail Delphi is about six weeks; most take about six months.

Money: Costs are moderate--$5000 and up. Main costs are in honoraria for experts, mailing, data reduction, and reporting.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: PSYCHOGRAPHICS or LIFE STYLE

Definition/description: This is a technique for correlating people's external needs, opinions, income, demographics, etc., with their actions and/or their stated opinions. AIO (reported elsewhere) is a variant of psychographics. Research on life ways (also reported elsewhere) is allied but distinct in that it deals explicitly with deep motivating values rather than with patterns of behavior.

History/degree of provenness/promise: Intuitive use of life styles for forecasting market and societal trends goes back a long ways. Its formal, academic use is hardly a decade old and is confined largely to market studies. The approach is far from proven. Its promise is probably greatest for broad-gauge market forecasting.

WHAT DO YOU GET?

Uses and limitations: Psychographic profiles correlate with many of an individual's views and actions. Can be used as a forecasting device by asking what people will do (want, etc.) under various circumstances. Limitations include inconsistency between what people say they will do and actually will do plus uncertainty as to consequences of acts even if the acts are as anticipated.

Form(s) of Output: Tables of correlations between psychographic specifics or patterns and single items of market action or beliefs.

Level of Detail: Detail tends to be middling to gross.

Level of Confidence: Low to very low. Variance data as high as 50% is unusual in market studies and seems not to be reported at all for social studies.

Span of Forecast: Most studies have focussed on the short-term (not over a year or so). Applicability of psychographics to forecasting long-term social trends is not clear.

HOW DO YOU DO IT?

Procedures: Individuals respond to questionnaires covering the areas of interest to the researcher. Correlations are then run and variance data derived.

WHAT DO YOU NEED?

Data requirements and availability: Main requirement is for a questionnaire of proven reliability (i.e., whose items truly reflect the issues under analysis).

People, Including Organizational Back-up: Expertise is required in questionnaire design, statistical analysis of results, and (often most important) in the generation of a conceptual model linking psychographics with actions and/or beliefs.

Time: Careful, controlled studies require a matter of months although impressionistic informal surveys can be done much more rapidly.

Money: Costs can range from under $1000 for a quick, impressionistic spot survey to tens of thousands of dollars for careful, extensive research.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: ACTIVITIES, INTERESTS, OPINIONS (AIO)

Definition/description: A technique for forecasting consumer buying (and other) patterns by correlating an individual's established buying habits with his activities, interests, and opinions. A special form of life style or psychographic research.

History/degree of provenness/promise: Developed in the mid 1960s by Wells and Tigert of the University of Chicago, Leo Burnett Advertising Agency, and Market Facts. It is one of the more reliable psychographic techniques of special promise in market research.

WHAT DO YOU GET?

Uses and limitations: Useful in forecasting buying patterns of many kinds of consumers. Its ability to forecast social attitudes and other "soft" issues is not established. Limitations include variable reliability depending on subject being forecast and apparent severe limits on degree of variance accounted for.

Form(s) of Output: Consumer "profiles" of demographics and AIO factors and how they correlate with specified consumer behavior (e.g., beer consumption, use of detergent, use of toothpaste).

Level of Detail: Most effectively used at level of class of goods or action (beer drinking or gardening) but AIO can be employed to distinguish between users of some brands within a product category.

Level of Confidence: Usually low--often very low. But in some areas (such as social consciousness) AIO plus demographics appear to account for over half the variance.

Span of Forecast: Duration of AIO characteristics is not definitely established but probably tends to be many years for a mature individual.

HOW DO YOU DO IT?

Procedures: The individual selects statements best describing him from some 300, supplies demographic information, and his practices with respect to various advertising media. This "profile" is then correlated with his actual buying (or attitudinal) pattern to arrive at variance data.

WHAT DO YOU NEED?

Data requirements and availability: Requirements include the AIO form, knowledge of consumer's buying practices in the area of interest, and capacity to reach the consumer to administer the questionnaire.

People, Including Organizational Back-up: Some statistical and computational expertise is required. Access to consumer panels is often helpful.

Time: Done informally (e.g., with walk-in buyers of product) a small study can be completed in a week; comprehensive controlled studies require several months or more.

Money: Minimum costs are the investigator's salary for a week or so; elaborate studies employing consumer panels or national probability samples would probably cost at least $50,000.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: LIFE WAYS

Definition/description: This variation of psychographics seeks to relate the inner values, images, and beliefs of people to their attitudes and actions. The attempt is to go deeper than the typical psychographic approach and to connect life ways with fundamental societal modes. Well-known life way typologies include those of Maslow, Erikson, Fromm, Graves (continued next page)

History/degree of provenness/promise: In a sense, this is an ancient mode of analysis and forecasting, going back to the great religious writings of many faiths. More recently many developmental theorists have used the concept of stages of growth (i.e., changing life ways) in people and societies to forecast and/or explain underlying societal trends. Polak (continued next page)

WHAT DO YOU GET?

Uses and limitations: Life ways help to provide normative gestalts (subjective descriptions) of plausible alternative futures, help set parameters on the timing and stages of various futures, point to which are "good," and suggest much about the economic, social, etc. aspects of societies dominated by (continued next page)

Form(s) of Output: Scenarios.

Level of Detail: Tends to be holistic and very broad. Middle-level societal detail can sometimes be inferred from life-way descriptions.

Level of Confidence: Low in the view of classical sociologists and historians. The key question is how self-fulfilling is a "vision of what might be."

Span of Forecast: Usually at least 10 years and commonly 50 years or more. This approach is especially adapted to very long-range societal forecasting.

HOW DO YOU DO IT?

Procedures: Adopt or invent a life way typology. Interpret past, present, and plausible future events in terms of it. Write plausible life way scenarios incorporating documentable trends leading to the various futures.

WHAT DO YOU NEED?

Data requirements and availability: Knowledge of life way typologies and how stages within a typology connect with each other and with external societal trends and characteristics.

People, Including Organizational Back-up: Life-way forecasts can be done by a single individual or by a team. Library and research assistance is helpful but not essential.

Time: A reasonably careful life-way scenario forecast can be put together in a week. Elaborate scenarios probing details take much longer.

Money: Ranges upward from 1-week, 1-man efforts.

LIFE WAYS, continued

Definition/description: Rostow, Kohlberg, Morris, and Mitchell. Perhaps the best known work using life ways as the base for describing a society in McClelland's The Achieving Society.

History/degree of provenness/promise: and others have pointed to the key role of "images" in "creating the future." The approach is far from proven but its promise is considerable in preparing macro-scenarios.

Uses and Limitations: specific life ways. Limitations are that life ways are more powerful descriptors than predictors, although some believe that the vision of a better life way is the key to attaining it. To the extent that people achieve the life ways they desire, this approach can be a good forecasting method.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: HISTORICAL ANALOGY

Definition/description: Used in both social and technological forecasting, the approach of historical analogy seeks to draw parallels between past events and what may occur in the future. Thus growth patterns in fossil fuels for 1800-1960 have been used to forecast the future of nuclear fuels. Similarly, the events surrounding the Protestant Reformation have been used to suggest the U.S. today is on the brink of a parallel social change.

History/degree of provenness/promise: One of the oldest techniques. If tempered with good judgment it provides very useful insights but generally not detailed forecasts. Used in conjunction with studies of the forces of change and their mechanisms, the approach appears promising.

WHAT DO YOU GET?

Uses and limitations: Most useful for suggesting likely directions of macro trends. Limitations are that events seldom repeat themselves exactly; in addition, the causal relationships presumed for one era or condition may not apply in other circumstances, no matter how apparently identical.

Form(s) of Output: Scenarios, parallels; usually qualitative rather than quantitative.

Level of Detail: Usually exceedingly gross, although trends of medium detail are sometimes identified in forecasts based on historical analogy.

Level of Confidence: Medium in terms of exact forecasts; high in terms of providing insight into plausible alternatives.

Span of Forecast: Medium to long--not good for very short-run forecasting.

HOW DO YOU DO IT?

Procedures: Find parallel conditions in another country, industry, time in history, etc. Argue that what happened elsewhere or before is a sensible basis for expecting a repeat performance. Adjust "duplicate forecast" by judgment based on identifiable difference between the two situations.

WHAT DO YOU NEED?

Data requirements and availability: Knowledge of condition being forecast and its commonalities with analogous situations. Data on historical conditions is often vague or misunderstood or not available.

People, Including Organizational Back-up: Specialists in social change; historians; experts in the area being forecast. Imaginative intellects seem necessary.

Time: Impressionistic forecasts based on historical analogy are often proposed in minutes; carefully documented forecasts require months.

Money: Ranges from very little to major.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: ALTERNATE FUTURES--Field Anomaly Relaxation Method (FARM)

Definition/description: This is a morphological forecasting method heretofore used mainly to describe plausible alternative futures for the U.S., although it is adaptable to smaller (regional, industry, etc.) units. Scenarios are built up by stringing together societal "snapshots" consisting of self-consistent combinations of societal elements (assembled via "field anomaly relaxation") selected from a systematically designed array of plausible possibilities.

History/degree of provenness/promise: This particular technique has been used chiefly at Stanford Research Institute for identifying plausible U.S. futures out to the year 2000. The technique forces systematic consideration of possible societal configurations. The method appears promising, especially for first-cut identification of broad future scenarios.

WHAT DO YOU GET?

Uses and limitations: Best adapted to comprehensive societal forecasting, but adaptable to lesser fields. Very helpful in broadening perspectives on the full range of possible futures. Limitations include fact that FARM is less predictive than descriptive or analytic. Plausibility judgments are highly subjective.

Form(s) of Output: Snapshots of societies strung together into a time-oriented sequence--i.e., a scenario.

Level of Detail: Tends to be exceedingly broad. Can be combined with documented trends to provide more detail.

Level of Confidence: Technique is less concerned with the level of confidence to be placed in a given scenario than it is with describing and dating the main lines of plausible future evolution of the subject being studied.

Span of Forecast: Most work to date has focussed on 3 to 30 years ahead, but this range could be reasonably extended to 50 years or more. FARM is not well suited for short-range forecasting.

HOW DO YOU DO IT?

Procedures: (1) Define 6 to 10 critical components of the subject being studied (e.g., for U.S. society: economics, technology, values, etc.) and array of possible conditions in each component (e.g., for economics: general prosperity, limited prosperity, recession, etc); (2) define self-consistent whole societies combining a single condition from each component area; (3) string together into scenarios of whole societies that seem plausible within forecast period; (4) date main stages.

WHAT DO YOU NEED?

Data requirements and availability: The chief requirement is a "feel" for how societies fit together--what can and cannot co-exist--together with the imagination to picture a wide range of plausible societies.

People, Including Organizational Back-up: In addition to an inventive team sensitive to the diverse aspects of imagining and describing societies, there is a need for much note-taking, drafting, and rewriting. Research assistance is essential if trends are to be documented with data.

Time: One month is probably minimum if one starts from scratch; six months is a more reasonable expectation for a comprehensive study.

Money: Costs would range from a low of a few thousand dollars to $100,000 or more.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: DIVERGENCE MAPPING

Definition/description: This is a system for judgmental identification of plausible future scenarios and their implications. The method is applicable to societal forecasting and to lesser units, such as regions, industries, or even products. The technique has its origin in morphological modelling and overlaps aspects of FARM, both of which are described elsewhere.

History/degree of provenness/promise: Divergence Mapping was invented in the early 1970s and thus far has been used for studying plausible alternative futures for corporations in several industries, for several states, etc. The method is proven in the sense that it definitely works. Exponents of the method feel that it promises well for applications in many untried areas.

WHAT DO YOU GET?

Uses and limitations: Principal uses include (1) identification of "best," "worst," and "most likely" futures for an organization or area; (2) emphasis upon strategic planning issues inherent in different kinds of futures; (3) surfacing of assumptions and perceptions concerning today and the future by those using the method. Limitations include suppression of predicting of forecasting the future in favor analysis of the plausible and possible.

Form(s) of Output: Sketchy scenarios of favorable, unfavorable, and likely futures for the organization, region, or product under study.

Level of Detail: In general the detail is very gross although certain trends or possible specific events usually emerge as requiring detailed attention.

Level of Confidence: The confidence to be placed in any specific alternative future coming to pass is low; confidence placed in Divergence Mapping as a method of introducing planners to "futures thinking" is high.

Span of Forecast: Most work to date has looked ahead 25 or 30 years, but this could be extended to 50 years or more by altering the "frames" (see below).

HOW DO YOU DO IT?

Procedures: (1) Critical issues for the organization (or region) under study are identified; (2) numerous snapshots ("frames") of societies reflecting these issues are written, (3) in a 3-day workshop members of the client organization (a) place these frames in tiers ranging from "likely to happen soon" to "remote in time," (b) string frames from the tiers together into "best," "worst," and "most likely" scenarios for the future, and (c) identify strategic planning issues implied by each scenario.

WHAT DO YOU NEED?

Data requirements and availability: Definition of critical issues for the organization are required; usually executives in the organization are aware of these.
People, Including Organizational Back-up: The project staff must be able to write plausible snapshots of societies reflecting various critical issues; the organization must be willing to free some of its senior staff for a 3-day workshop. Reportorial requirements are medium.
Time: Six weeks is minimum from start to finish; three to four months is a more reasonable schedule.
Money: In the form described above, costs average about $15,000. Inclusion of detailed data back-up for trends incorporated in the "frames" will increase the cost. Cost will be reduced if off-the-shelf frames are utilized in the workshop.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: INTROSPECTIVE FORECASTING

Definition/description: This approach involves the creation of inner pictures of the future. It might be called "prescience," "clairvoyance," "zen forecasting," or "vision foresight."

History/degree of provenness/promise: This is easily the most ancient mode of forecasting, going back to soothsayers, the reading of tea leaves, the Delphic oracles, I-Ching, and similar occult arts. Nostradamus was a famous practitioner of this mode of looking ahead. The method is so far from proved that its promise is negligible in the absence of a methodological breakthrough.

WHAT DO YOU GET?

Uses and limitations: Approach is useful to elicit the thinking of "mystics" or others who have trouble working in more systematic modes. Limitations are that forecasts are often ambiguous, their origins are seldom traceable, and they are usually very fragmentary (deal with but one of many aspects of a situation).

Form(s) of Output: Scenarios, epigrams, parables, stories, "visions," dreams, pictures.

Level of Detail: Range from the universal ("end of world" forecasts) to very specific (earthquake of X magnitude at Y place at Z time).

Level of Confidence: Forecasts are almost completely uncheckable by normal means. Forecasts of specific future events (e.g., earthquake) have proved about 100% wrong.

Span of Forecast: Range from near term literally to eternity.

HOW DO YOU DO IT?

Procedures: Introspective forecasting is an art and as such is done differently by most practitioners. Techniques such as meditation, certain games, psychedelic drugs, biofeedback, yoga, etc., often help in producing this kind of forecasting.

WHAT DO YOU NEED?

Data requirements and availability: No data requirements.

People, Including Organizational Back-up: Such forecasters usually work in isolation.

Time: These forecasts often occur of themselves rather than emerge on command.

Money: Often free; if not an honorarium may be involved.

FORECASTING EVALUTION FORM #1

WHAT IS IT?

Name: UTOPIAS/DYSTOPIAS

Definition/description: These are (usually fictionalized) accounts of glorious or terrifying societies. Commonly some satire is involved. Utopias and dystopias differ from science fiction in tending to treat the whole of society and, perhaps, in being a bit less fanciful.

History/degree of provenness/promise: This form of forecasting is very old, going back at least to ancient Greece. Some of the genre are considered to have been very useful socially as satire or as a warning of things to watch out for. In general, they have not been taken seriously as forecasts.

WHAT DO YOU GET?

Uses and limitations: Very useful as "freeing" devices to spur normative thinking about where a society wants (or doesn't want) to go. As forecasts most utopias and dystopias are unsystematic and also fail to deal with how today might turn into the pictured condition.

Form(s) of Output: Usually in fictionalized narrative.

Level of Detail: Cover the gamut from global to highly specific.

Level of Confidence: Confidence in utopias/dystopias is low as forecasts of what will be; as conceivable (if not predicted) futures they are often highly convincing. Actually, purpose of some dystopias (e.g., 1984) is essentially to help that future not come into being.

Span of Forecast: Not applicable in most cases.

HOW DO YOU DO IT?

Procedures: Writing of fiction.

WHAT DO YOU NEED?

Data requirements and availability: None.

People, Including Organizational Back-up: Just an author, who seldom works within an organizational framework.

Time: Not applicable.

Money: Not applicable.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: MODES AND MECHANISMS OF SOCIAL CHANGE

Definition/description: This approach seeks to forecast the timing, direction, nature, and magnitude of social change through analysis of mechanisms and patterns of change. These include such phenomena as discontinuities, collision trends, new perceptions and priorities, diffusion patterns, change-over points, etc.

History/degree of provenness/promise: This kind of thinking is used implicitly by many forecasters but it has seldom been systematized and related to change in various sectors of the society. The approach appears promising in that it would markedly enrich and refine forecasts derived by other means (especially scenarios).

WHAT DO YOU GET?

Uses and limitations: The approach probably applies most usefully to social change although it has also been applied effectively to technological forecasting. Limitations include present undeveloped state of the approach and fact that it is not applicable to purely physical issues, such as weather, resource supplies, etc.

Form(s) of Output: Models relating change mechanisms to specific areas, such as social disruption, awareness of issues, conflicts of interest, "ideas whose time has come."

Level of Detail: Very broad, although perhaps expressed in probabilistic mathematics.

Level of Confidence: Medium to low at present; level might be raised by more sophisticated research.

Span of Forecast: Best for medium (5 years) and longer. The approach promises well for very long-range forecasting (50 years and more).

HOW DO YOU DO IT?

Procedures: One studies the apparent reasons for past change in the area of interest. Using these data, models are constructed and tested in similar conditions elsewhere. By analogy or directly these insights and relationships as applied to current issues, facilitating forecasts of when, where, how, and how much change is to be anticipated over specified time periods.

WHAT DO YOU NEED?

Data requirements and availability: Enough data is required to justify an intuitive or mathematical model of the phenomena of interest. Often the available data are fuzzy and soft.

People, Including Organizational Back-up: Key need is for imaginative social generalists knowledgeable about where to obtain detailed data if they are required. The technique could be computerized, although that probably isn't justified at present.

Time: Intuitive models of change mechanisms can often be sketched in a day. Detailed back-up and documentation takes much longer.

Money: Useful work can be done for less than $1000. Original and comprehensive description of the principal change processes entering a complex social system might cost $250,000 or more.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: STUDY OF FORCES OF CHANGE

Definition/description: Instead of looking at historical trends and events, the forecaster examines the forces underlying trends and events, such as growth processes, changing values, social conflicts, or shifting emphasis in education, R&D, or acceptance of new ideas. In forecasting on the basis of change-generating forces, the researcher uses many techniques, such as precursor events, social surveys, cross-impact analysis, etc.

History/degree of provenness/promise: This approach has been extensively used by social historians and philosophers but it has not yet been systematized into a specific methodology. The method has much promise although it is too early to assess prospects for major improvements in societal forecasting.

WHAT DO YOU GET?

Uses and limitations: Useful for separating symptoms from causes. The approach is applicable to broad-gauge of specific forecasting. Limitations include an undeveloped state of the art and uncertain cause/effect relationships in many fields.

Form(s) of Output: Complex scenarios indicate emerging change forces and their probable consequences for the future.

Level of Detail: Tends to be broad.

Level of Confidence: Not clear because technique is very undeveloped.

Span of Forecast: Emphasis on long-term--10 years and up; approach is well adapted to very long range forecasting.

HOW DO YOU DO IT?

Procedures: (1) Identify the key physical, organizational, ideological elements underlying the field(s) to be forecast; (2) forecast trends in these areas; (3) develop implications and effects in terms of the study field; (4) cross-check with forecasts derived in other ways.

WHAT DO YOU NEED?

Data requirements and availability: Deep knowledge of change forces along with model(s) linking underlying cause with external events being forecast.

People, Including Organizational Back-up: Area specialists, social theorists (to devise model), scenario writers. Computer manipulation of models is sometimes helpful.

Time: A month would be minimum for a limited study; major societal studies could easily take a year or more.

Money: $5000 and up.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: MACRO HISTORICAL CYCLES

Definition/description: In the view of many historians, nations pass through distinct stages or cycles in their evolution--cycles that tend to repeat themselves. Toynbee, Sorokin, Spengler, and Marx have discussed such cycles. The existence of recognizable cycles and an understanding of how and when stages emerge provides a powerful, if very general, societal forecasting tool.

History/degree of provenness/promise: The approach is classic. Currently, the numerous futurists who see the U.S. as on the verge of a "new epoch" usually draw comparisons with times past, although they may not see it as a repetitive process. The promise of this approach depends on one's sense of how much history repeats itself vs. how fundamentally different today's world is from any past situation.

WHAT DO YOU GET?

Uses and limitations: Like other approaches based on historical analogy, this one is an excellent starting point and heuristic for forecasting. Limitations are severe because the approach excludes the potential of a nation moving ahead to a form "beyond" anything known to history and hence noncyclic.

Form(s) of Output: Scenarios that extensively utilize historical precedent.

Level of Detail: Extremely general and gross. Subscenarios within the macro change can deal with finer detail.

Level of Confidence: In general the confidence level is medium on the generic level and low on specifics.

Span of Forecast: Tends to be very long range--up to 100 years or more.

HOW DO YOU DO IT?

Procedures: One invents or adopts a theory of national evolution. (Sorokin's goes from Sensate, to Late Sensate, to Ideational, to Integrated, back to Sensate.) The nation under study is described in terms of the model and thus placed in the cycle. Inferences are then made about when and how the country will enter the next phase, etc.

WHAT DO YOU NEED?

Data requirements and availability: Considerable requirements for historical data to butress the cycle model--which is often unobtainable except by inference--plus data on the nation under study.

People, Including Organizational Back-up: Historians and experts in social change are the principal requirements.

Time: An impressionistic first cut can be done in a week or two. Detailed analysis and attitudinal comparisons require many months, if not years.

Money: First cuts might cost a few thousand dollars. Major documented studies would be very expensive.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: CROSS-CULTURAL COMPARISONS

Definition/description: This important variant on historical analogy (described elsewhere) depends on the idea that what people do in given circumstances is pretty much the same all over the world (or nation). Thus it is said that what happens in the U.S. will occur in England and Europe 3-6 years later. Cross-cultural comparisons systematize and quantify this approach.

History/degree of provenness/promise: Roots of this approach lie in anthropology and studies of stages of growth of nations. More recently elaborate cross-national studies have been made not only of GNP, education, population, productivity, etc., but of values and social priorities. The relationship of specific indices and social change is roughly established, but much remains to be done to devise truly reliable models.

WHAT DO YOU GET?

Uses and limitations: Cross-cultural comparisons are useful as indicators of possible future trends, but at present they are little more than that. Lack of consistent correlations plus differing national styles severely limit the approach.

Form(s) of Output: Historical accounts incorporating surrounding trends. Some studies present parallel data for many nations, allowing direct comparisons.

Level of Detail: Detail is usually of middling level (e.g., number of cars, birth rate, GNP, etc.)

Level of Confidence: Not high at present state of the art, except for the most global trends (i.e., a nation is at "take-off stage," or is reaching a "mass economy.")

Span of Forecast: Speculations range to 50 years and more ahead.

HOW DO YOU DO IT?

Procedures: Devise a social development model correlating specified indices with development changes. Apply what seems to hold for one nation (or region) to a nation (or region) at an earlier stage. Forecast change on the basis of parallelism, adjusted by subjective judgment.

WHAT DO YOU NEED?

Data requirements and availability: Parallel data for many nations. Useful data are often not available or not reliable or not parallel. UNESCO studies are improving the situation. Sometimes necessary to collect original data.

People, Including Organizational Back-up: Research calls for sociologists, economists, statisticians, historians, and often others. Computers for model development and manipulation are almost essential.

Time: Any appreciable study will take months, if not a year or more.

Money: Very little can be done for less than $25,000. Any study requiring new data will far exceed $100,000.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: SYNECTICS

Definition/description: Synectics is an approach to inducing creative thinking, which may be applied to inventing products, social issues, alternative futures, etc. Thinking in analogies plays a major role in the 9-step process defined as Synectics. The system might be an aid to forecasting; it does not, in itself, produce forecasts.

History/degree of provenness/promise: Developed largely by W.J.J. Gordon in the 1960s, Synectics has proved very helpful in solving a variety of mechanical and people problems in industry. The technique might also be applicable to solving social insues or to inventing ways to "create" the future.

WHAT DO YOU GET?

Uses and limitations: The technique forces imaginative, non-routine thinking about (usually old) problems and often comes up with "inspired" solutions. By no means always successful, the methods when applied to forecasting and social issues would probably prove stimulating rather than analytical.

Form(s) of Output: Clarified problem statements with one or more approaches to solution.

Level of Detail: Often exceedingly detailed.

Level of Confidence: Ranges from clear solution to the problem (100% confidence) down to failure.

Span of Forecast: Not applicable. Synetics might help investigators envision the future more clearly or invent approaches to solving some societal issues but it is not intended as a means of making actual forecasts.

HOW DO YOU DO IT?

Procedures: Under the direction of a leader, a group analyzes a specific problem, thinks about it in terms of several analogies, examines possible solutions, and "force-fits" these to the specifics of the problem.

WHAT DO YOU NEED?

Data requirements and availability: Data on the problem and prior, unsuccessful approaches to its solution.

People, Including Organizational Back-up: A group leader familiar with Synectics is required along with people willing to try out fresh, "weird" approaches to solving problems. The organization must be willing to try the unusual.

Time: Minimum of a few weeks.

Money: Instruction manuals are available for do-it-yourself Synectics sessions. Costs will be largely for salaries. Courses in Synectics are also available. Synectics, Inc. will also conduct sessions on specific problems for fees of about $3000.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: BRAINSTORMING

Definition/description: In this technique for evoking creative thinking, a group (rarely an individual) accepts a very precise problem and comes up with as many ideas as possible concerning its solution. Every idea, no matter how remote, is accepted. Success of the method seems to depend on the freedom and imagination used in inventing ideas. Only at a later stage are the ideas tested for practicality. Synectics is a more structured variant of brainstorming.

History/degree of provenness/promise: An old technique systematized during the 1950s in industrial and academic settings. Results are varied, with a very few outstanding successes. In general brainstorming is less popular than it once was. Now used mostly as an aid to analysis and decision-making.

WHAT DO YOU GET?

Uses and limitations: Especially good for long-term forecasts with a big normative component. For some purposes (classified, military, etc.) "operational creativity" is used in which the exact nature of the problem is known only to the leader, who takes an active, directive role. Limitations are the unsystematic results and the lack of documentation.

Form(s) of Output: Statements of ideas, possibilities, approaches, forecasts.

Level of Detail: Tends to be general, but can be very detailed if the brainstormers are specialists in the field.

Level of Confidence: Erratic--an occasional "breakthrough" idea.

Span of Forecast: Can be for any period; the technique is well adapted to long-range forecasting.

HOW DO YOU DO IT?

Procedures: A group freely discusses a problem from many angles, and comes up with large numbers of different approaches or solutions. The (doubtful) theory is that the more ideas the greater the likelihood of a solution.

WHAT DO YOU NEED?

Data requirements and availability: Requirements for data come after the brainstorming, to check the praticality of proposed solutions.

People, Including Organizational Back-up: Needed: Inventive panel members generally or specifically expert in the subject being studied; a leader able to ask evocative questions and free people of inhibitions; a recorder and summarizer.

Time: Brainstorming sessions can last a morning, a day, or a week (in the case of large groups discussing a variety of interrelated problems).

Money: Basically an inexpensive technique; salaries are the principal cost element.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: BIONICS

Definition/description: Bionics is the study of social or mechanical systems through analogy of living systems. (Cybernetics is the reverse.) Best known as an approach to inventions (bat's hearing led to radar, etc.), bionics also have applications in societal development (parallels with individual's growth), social and organizational models (biological growth, entropy, etc.), etc.

History/degree of provenness/promise: Bionics is a post-war development that has produced spectacular successes in designing or inventing mechanisms. Its use in social analysis and forecasting is much less developed except in the use of biological growth curves to forecast rates of future change. A promising area is parallelism between change in individuals and that in societies and organizations.

WHAT DO YOU GET?

Uses and limitations: Bionics is most useful as an idea generator; usually it does not result in explicit forecasts. The approach suffers from the inexactitudes of any analogy.

Form(s) of Output: Diverse--growth curves, models, scenarios, etc.

Level of Detail: Often applied to very exact technical problems, but for social or market forecasting the level of detail tends to be medium (sales have passed region of highest growth; it is unreasonable to expect the speed of aircraft ever to exceed X).

Level of Confidence: Depends wholly on the situation.

Span of Forecast: In general, span is medium to long; the technique is not well adapted to very short-term forecasts.

WHAT DO YOU NEED?

Data requirements and availability: Vary enormously. Intuitive understanding is sufficient in some cases.

People, Including Organizational Back-up: Inventive, creative minds are the key ingredients.

Time: Growth curves can be usefully applied very rapidly; sophisticated natural models require much longer.

Money: To use existing bionic techniques is inexpensive; to advance the state of the art would be costly, perhaps $50,000 and up.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: SCIENCE FICTION AS FORECASTS

Definition/description: Science fiction writers over the last century have projected a variety of futures usually in a holistic context. Their insights can be useful as an adjunct to formal forecasting, particularly as an early warning device.

History/degree of provenness/promise: Some writers, Verne, Wells, Clark have been remarkably adept at foreseeing new technology. Orwell's specter of 1984 has been useful in the era of Watergate.

WHAT DO YOU GET?

Uses and limitations: Useful in forming a preceptual context for forecasting. With rare exceptions, however, it contains primarily wishful or fearful thinking rather than well thought out analysis.

Form(s) of Output: Novels, short stories, films.

Level of Detail: Very broad, usually whole societies.

Level of Confidence: Suggestive of ideas and developments.

Span of Forecast: From a few years (On the Beach) to the far future (Childhood's End).

HOW DO YOU DO IT?

Procedures: Identify on a regular basis the few good science fiction books published and read as general background.

WHAT DO YOU NEED?

Data requirements and availability: None.

People, Including Organizational Back-up: Someone who is familiar with the literature can be helpful in suggesting the better works.

Time: Little, just reading time.

Money: The cost of the books.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: EXPONENTIAL SMOOTHING

Definition/description: Like moving averages, historical data provides average which becomes forecast value. Different in that more recent data is given increasing weight.

History/degree of provenness/promise: Widely used for short-term forecasts, where pattern of data is regular and no major changes anticipated.

WHAT DO YOU GET?

Uses and limitations: Is a little more accurate than moving averages, but only useful for very orderly data.

Form(s) of Output: Quantitative data for next time period.

Level of Detail: Forecast of a single quantity.

Level of Confidence: High confidence with a regular pattern.

Span of Forecast: Equal to the equal intervals of the historical data.

HOW DO YOU DO IT?

Procedures: Determine weighting coefficient (α) on basis of historical data and solve equation $S_t + 1 = S_t + \alpha(X_t - S_t)$

S_t = forecast for time t

X_t = actual value at time

α = weighting coefficient

WHAT DO YOU NEED?

Data requirements and availability: Historical data over at least three equal time periods.

People, Including Organizational Back-up: Requires no sophisticated skill, but is often computerized.

Time: Very quick.

Money: Low cost.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: SIMPLE REGRESSION

Definition/description: A linear algebraic relationship is defined between two variables. The statistical method of least squares is used to determine the equation of the relationship.

History/degree of provenness/promise: Very widely used, when a linear pattern is identifiable.

WHAT DO YOU GET?

Uses and limitations: May be used when there are sufficient historical data to define the linearity of the relationship.

Form(s) of Output: Quantitative forecast of specific values over any period into the future.

Level of Detail: Deals with only two variables.

Level of Confidence: High confidence when linearity is of a long duration and there are no expected events which may modify the relationship.

Span of Forecast: No limit.

HOW DO YOU DO IT?

Procedures: Historical data is collected, least squares applied to determine coefficients of regression equation, equation solved for desired time span.

WHAT DO YOU NEED?

Data requirements and availability: Accurate historical data of any interval and a fair number of points.

People, Including Organizational Back-up: Requires some statistical expertise, usually involves computers.

Time: Relatively quick.

Money: Can be expensive if data collection is difficult cost of computer time.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: MOVING AVERAGES

Definition/description: Uses historical data which is "smoothed." Extremes are discarded by averaging. Average of the known values becomes the forecast for the next time period. When that becomes a known value, average is re-calculated for the next forecast, hence, moving average.

History/degree of provenness/promise: Very old technique. Anticipated error can be very precisely determined. Widely used in operational forecasting.

WHAT DO YOU GET?

Uses and limitations: Limited to one time period into the future--time period determined by historical data i.e. if data is every five years then can forecast five years into future. Can only be revised at end of time period. Useful when historical pattern is simple. Little variance and change is nearly linear.

Form(s) of Output: Quantitative value for next time period.

Level of Detail: Can forecast only a single quantity.

Level of Confidence: If pattern is very regular--little variance--then confidence is high.

Span of Forecast: Determined by time periods of historical data.

HOW DO YOU DO IT?

Procedures: Calculate average of known values - recalculate at end of forecast period using new known value.

$$S_{t+1} = \frac{X_t}{N} - \frac{X_{t-N}}{N} + S_t$$

S_t = forecast for time t

X_t = actual value at time t

N = number of values included in the average

WHAT DO YOU NEED?

Data requirements and availability: Historical data over at least three equal time periods.

Time: Very quick, conditioned only by data availability.

Money: Very inexpensive.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: MULTIPLE REGRESSION

Definition/description: A linear algebraic relationship is defined among several variables including the one to be forecast. Least squares is applied to historical data to solve the equation.

History/degree of provenness/promise: Very widely used when a linear relationship is present.

WHAT DO YOU GET?

Uses and limitations: May be used when there is sufficient historical data to assure the linearity of the relationship among the several variables.

Form(s) of Output: Quantitative forecasts of a single variable.

Level of Detail: Can deal with multiple variables, but forecast only one.

Level of Confidence: High confidence when the historical relationships are well established by standard statistical tests.

Span of Forecast: No limit.

HOW DO YOU DO IT?

Procedures: Least squares method applied to historical data to specify coefficients of the regression equation. Equation is then solved for desired time span.

WHAT DO YOU NEED?

Data requirements and availability: Requires extensive historical data.

People, Including Organizational Back-up: Sophisticated statistical skills and computer.

Time: After data collection, time to produce forecast is brief.

Money: Can be costly in computer time.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: ENVELOPE CURVES

Definition/description: It is a method using the envelope created by earlier data to predict the rate of development in a particular area of technology.

History/degree of provenness/promise: Very widely used and proven in limited applications.

WHAT DO YOU GET?

Uses and limitations: Can predict the advance of a particular technological parameter e.g., speed, but not the nature of new technology, cannot account for major breakthroughs.

Form(s) of Output: Quantitative forecast of single parameter.

Level of Detail: Single parameter.

Level of Confidence: High when envelope is consistent over long periods of time.

Span of Forecast: Limited by anticipated parameters of new technology.

HOW DO YOU DO IT?

Procedures: A series of "S" curves is developed to define the envelope. The limits of the envelope define the limits of the forecast "S" curve.

WHAT DO YOU NEED?

Data requirements and availability: Extensive historical data.

People, including Organizational Back-up: Sophisticated statistical skills and computer.

Time: Can take a long time to collect and fit the data.

Money: Costly in manpower and computer time.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: GROWTH CURVES

Definition/description: Many phenomena seem to follow the "S" shaped growth pattern of exponential growth slowing near a limit. Forms of the equation for this pattern are known as the Gompertz Curve and Pearl Curve.

History/degree of provenness/promise: This has been widely used--but proven only in biological tests.

WHAT DO YOU GET?

Uses and limitations: May be used when data fits and an upper limit is known. Can predict turning points in the curve.

Form(s) of Output: Quantitative forecast of a single quantity and turning points.

Level of Detail: Single variable over time.

Level of Confidence: When data correlates well with growth model confidence is high. The further along the curve the present is, the easier it is to achieve a significant correlation.

Span of Forecast: No theoretical limit.

HOW DO YOU DO IT?

Procedures: Using historical data and statistical tests of goodness of fit the appropriate curve is matched to the data and a forecast is produced.

WHAT DO YOU NEED?

Data requirements and availability: Historical data of a single variable being forecast.

People, Including Organizational Back-up: Sophisticated statistical skills and usually a computer.

Time: Very quick if data and standard computer curve fitting routines are available.

Money: Expensive to develop, inexpensive to run.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: LINK-RELATIVE PREDICTION OF TURNING POINTS

Definition/description: This is a way of accounting for short-term changes in time series trends by considering the average change over each historical interval.

History/degree of provenness/promise: As this is a fairly naive method in that it has no associated causal model, it is not widely used.

WHAT DO YOU GET?

Uses and limitations: Good for very short term, i.e., the next time interval.

Form(s) of Output: An adjustment factor to modify the forecast for the next interval.

Level of Detail: One variable over time.

Level of Confidence: Fairly high in the short term when the interval to interval variance is low, i.e., a highly linear trend.

Span of Forecast: The next time interval.

HOW DO YOU DO IT?

Procedures: The average of the percent changes over intervals is calculated. It is then applied to the forecast value.

WHAT DO YOU NEED?

Data requirements and availability: Historical data over equal intervals.

People, Including Organizational Back-up: Requires no sophisticated skills.

Time: Very quick.

Money: Very inexpensive.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: BOX-JENKINS

Definition/description: Designed to handle complex time series or where the basic pattern is not apparent. Through a series of iterations the underlying pattern of the data is identified. This pattern is then used to generate the forecast.

History/degree of provenness/promise: Fairly new (1970), considered powerful but difficult.

WHAT DO YOU GET?

Uses and limitations: Used for complex data, but costly and time consuming.

Form(s) of Output: Quantitative forecast based on multiple variables.

Level of Detail: Can handle many variables.

Level of Confidence: Very good in the medium span.

Span of Forecast: Short to medium, no more than a few intervals.

HOW DO YOU DO IT?

Procedures: An initial pattern is specified, tested and modified through several iterations using the statistical methods of auto correlation and lagged variables.

WHAT DO YOU NEED?

Data requirements and availability: Time series data.

People, Including Organizational Back-up: Sophisticated skills and computer.

Time: Long to develop pattern and forecasting algorithm, brief to forecast.

Money: Expensive in development.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: CYCLE ANALYSIS

Definition/description: A variety of trends seem to follow cyclic patterns. If the cycle can be identified it can be used to modify trend forecasts by specifying the turning points.

History/degree of provenness/promise: Short term (e.g. business cycles) are widely used. Longer term (e.g. Kondratieff Wave) are more questionable.

WHAT DO YOU GET?

Uses and limitations: May be used primarily to identify turning points in known trends. Many longer term cycles are highly debatable as to the reality of the cyclic behavior.

Form(s) of Output: Forecast of turning point.

Level of Detail: Usually quite broad (e.g. all economic activity).

Level of Confidence: Short term-high, long term???

Span of Forecast: Usually one pass through the full cycle.

HOW DO YOU DO IT?

Procedures: Identify the relevant cycle and the timing of the next turning point.

WHAT DO YOU NEED?

Data requirements and availability: Access to information on cyclic behavior and available forecast data.

People, Including Organizational Back-up: Requires someone (usually statistician) to evaluate relevance of cycle to problem at hand.

Time: Brief.

Money: Low cost.

Steiner 1969, p. 390-412
Jantsch 1969, p. 239

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: SYSTEMS ANALYSIS

Definition/description: Broadly, systems analysis refers to an orderly analytic study of a system which is designed to help a decision-maker identify a preferred course of action from among possible alternatives to achieve an objective. It is primarily an "art" that requires specialized mathematical techniques of Operations Research.

History/degree of proveness/promise: Developed by the RAND Corporation in 1948 to optimize complex problems of military management. Wide application in the U.S. Besides military applications, this approach is used in industry for market (demand) factors, supply alternatives and in social science and general planning.

WHAT DO YOU GET? A way to deal effectively with important, broad, and ill-structured problems. It is not a tool or technique so much as a way of thinking.

Uses and limitations: Take a large task and divide it into manageable subtasks. Helps decision-makers to sharpen their judgments.

Problems: (1) fail to address the problem; (2) rely too heavily on the quantitative methods as to forget the "real world." Also, the analysis is necessarily incomplete and approximate.

Form(s) of Output: Problem dependent; however, usually numerical results often associated with costs as a selection criteria.

Level of Detail: Although generalized application to broad scope problems, the methods often focus on specific details.

Level of Confidence: A standard approach in engineering and accepted in most other fields. Tends to be too mathematical for many interests.

Span of Forecast: Covers the entire span of forecasts short, medium and long-range.

HOW DO YOU DO IT?

Procedures: (1) Formulate the problem, (2) choose objectives, (3) define the environment, and (4) judge the reliability of data and the analyst.

WHAT DO YOU NEED? Depends on the specific problem.

Data requirements and availability: Depends upon the specific problem.

Systems Analysis: An approach to complex problems of choice under uncertainty by systematically examining the costs, effectiveness, and risks of various alternatives (Quade 1973).

Steiner, 1969, p. 444-46
and David B. Hertz, "Investment Policies that Pay Off,"
Harvard Business Review, Vol. 46,
Jan/Feb 1968 p. 96.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: **RISK ANALYSIS SIMULATION**

Definition/description: A computer simulation to improve capital investment decision making and maximize the changes of attaining long-term dollars and cents investment objectives. Assists in establishing an investment policy.

History/degree of provenness/promise: Developed by David Hertz (prior to 1964) to improve investment decisions. Despite this description, the simulation should be further explored for Corps application.

WHAT DO YOU GET?

Uses and limitations: Simulates possible investment outcomes to get distribution of probabilities concerning payoff and assesses the risk of various policies to provide a means of making effective investments for growth. Limitations: selecting key factors and assigning uncertainty profiles; also, choice of criteria against which to measure results.

Form(s) of Output: A risk profile or a probability distribution for future revenues from a given investment.

Level of Detail: Aggregate level of detail, based on broad factors and criteria.

Level of Confidence: Higher than existing one-point estimate.

Span of Forecast: Probability of return on 1 to 10-year investments usually simulated over a 15-year period.

HOW DO YOU DO IT?

Procedures: Yes: (1) Construct uncertainty profiles for each important factor.
(2) Computer simulates an actual situation.
(3) Computer combines the values selected and determines a return on investment for this particular situation.
(4) Computer reports this process and calculates ROI several thousand times.
(5) Computer lists the results and specifies the number of times the ROI falls in a given range.
(6) Cumulative probabilities can then be used to draw a risk profile.

WHAT DO YOU NEED?

Data requirements and availability: Data sometimes determined from historical or other objective data, but usually subjective estimates by those familiar with the problem. Communication problems with subjective estimates.

People, Including Organizational Back-up: Decision makers familiar with problem and/or analyst knowledgeable about simulation. Computer backup.

Time: Less than 6 months.

Money: Low to medium (guess).

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: CONTEXTUAL MAPPING

Definition/description: Contextual mapping is a type of exploratory forecasting. It is a broad concept used to follow combinations of current and possible future technologies in expected future environments.

History/degree of provenness/promise: Utilized by the RAND Corporation in the late 1940's. Applied mainly to military planning and industrial technological developments. Seems to have been applied very successfully, but I am not sure what it is.

WHAT DO YOU GET?

Uses and limitations: Quantitative contextual mapping is of particular value in forecasting the effects of scaling. Used generally in defining new missions and conceiving future complex systems. It is considered of potential value within the framework of social technology.

Form(s) of Output: Detailed charts or picture flows (?)

Level of Detail: A wide range from minute detail to generalized flows.

Level of Confidence: Generates new, though "inaccurate", information about specific functional capabilities or parameters.

Span of Forecast: Long-range forecasts.

HOW DO YOU DO IT? Need other references.

Procedures:

WHAT DO YOU NEED?

Data requirements and availability:

People, Including Organizational Back-up:

Time:

Money:

R.E. Bain, et al., "A Model of the Energy Market," 1973-74 Draft.
Personal Communication, S.Baum & E.Cazalet

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: SRI GULF ENERGY MODEL

Definition/description: An energy market model whose purpose is to compute energy, supplies, demands, and prices over a given horizon. The mathematical algorithms determine the equilibrium between supply and demand based on price.

History/degree of proveness/promise: Developed in 1973-74 by SRI for Gulf Oil Corporation. Considerable promise. Gulf is incorporating existing model into its management structure and SRI is proceeding with further expansion and discrimination. General methodology may be applied to other activities and at various levels of detail. Corps may be a potential user.

WHAT DO YOU GET?

Uses and limitations: Based on projected consumption, the model computes prices for selected energy sources. Projects market prices and energy flows throughout the U.S. energy system by balancing supply and demand. Limitation: Runs and testing tend to be costly; decision focused on specific supply/demand problems; and present "red tape" involved with acquisition and use. At the present time, more like a paid service than tool to work with.

Form(s) of Output: Computer listing and graphs of supply, demand and prices on a regional basis for various forms of energy resources and levels of technology.

Level of Detail: National model with regional detail.

Level of Confidence: Both proponents and customers show enthusiasm for this model as a decision analysis tool. While the model is new and there has been only one application, designers express confidence in the basic design and methodology.

Span of Forecast: "Precision" geared to medium or long-term forecasts.

HOW DO YOU DO IT?

Procedures: Since the model is running the procedure to use it in its present form is mainly related to data review and model acquisition.

WHAT DO YOU NEED?

Data requirements and availability: Critical data inputs but not large volumes of historical data. Some data based on subjective estimates. Data generally available; however, user must pay royalties to use the model.

People, Including Organizational Back-up: At the present time, it is necessary to contact either SRI or Gulf to acquire and become familiar with the model.

Time: Primarily for acquiring the model, familiarization, and data, review and interpretation.

Money: Medium to high: $200 - $500/run.
Development costs at 1/2 million dollars.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: GAMES

Definition/description: Gaming is a special type of model-building, structured so as to permit multiple simultaneous interactions among competing and cooperating players.

History/degree of provenness/promise: Gaming has experienced a wide range of applications from military war games to industrial strategy to social planning and development. Gaming can be extended up to the highest levels of social systems and society, and is becoming recognized as one of the potentially most suitable techniques for "social engineering".

WHAT DO YOU GET?

Uses and limitations: Can be used for studying the implications for the future of combinations of specific strategic concepts. Seems to be an effective means of forecasting the possible impact of new or future plans to a limited number of players.

Form(s) of Output: Besides the individual perceptions and experiences acquired during games, most have some type of quantitative, measurable output.

Level of Detail: Generalized and aggregate. Can be used for studying the implications of future scenarios.

Level of Confidence: Highly subjective but testing procedures indicate excellent learning value.

Span of Forecast: No limits.

HOW DO YOU DO IT?

Procedures: Most games employ a structured but flexible framework in which players must operate.

WHAT DO YOU NEED?

Data requirements and availability: People and a game. Development may require historical or hypothetical case studies.

People, Including Organizational Back-up: Any number of players, ranging from two to 200; the average is 10 to 30.

Time: The actual game usually requires from one day to one week. Preparation and development time may be lengthy.

Money: Costs for development, preparation, players and often computer. Small to medium.

Johnson Preprint 1974
Hammond

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: POLICY CAPTURE

Definition/description: A small group technique. Utilizes multivariate statistical analysis to compute explicitly the relative importance assigned to different variables in a problem based upon the assigned preferences for different solution scenarios for a problem.

History/degree of provenness/promise: Developed by K. R. Hammong, University of Colorado in (guess) late 1960's. Besides a mapping of human judgments, policy capture can be used to generate effectiveness measures for budgetry decisions. High degree of promise.

WHAT DO YOU GET?

Uses and limitations: Policy capturing provides normative information on the ramifications of alternative policies in order to surface issues imbedded within the problem situation. No "sure" method to select the proper set of cues; need policy people who are hard to get, analysis dependent on linear regression.

Form(s) of Output: Numerical values and/or bar charts and computer graphics for each cue showing relative weights, preferences, and "way of thinking."

Level of Detail: Aggregate variables (5 to 10) used to describe problem or situation.

Level of Confidence: General level of acceptance is high, excellent opportunity for feedback and refinement.

Span of Forecast: Scenarios may extend into any time frame.

HOW DO YOU DO IT?

Procedures:
1. Discuss the problem and formulate the cues or variables.
2. Pretest: set up program and administer.
3. Data analysis
4. Present results and review

WHAT DO YOU NEED?

Data requirements and availability: Subjective data. Inputs on preselected questions from participants.

People, Including Organizational Back-up: Works best with people directly involved in the problem. Need access to Policy II computer program.

Time: Development time less than 6 months. To administer test takes from 1 day to 1 week.

Money: Low to medium. Requires extensive preparation and pretesting, as well as computer costs @ $8 to $20/run.

<antech, 1969, p. 163

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: PROBABILISTIC FORECASTING

Definition/description: Various statistical methods that include:
Stochastic processes: chain of events with transition probabilities that are not affected by what happened at earlier stages.
Markov chains: a stochastic process for which all transition probabilities could be determined.
Gaussian: normal distribution characterized by the standard deviation.
Bayesian statistics: non-Markov and possible to update probability distributions by the introduction of new data.
Monte Carlo: is an experimental, not an analytical, technique by which a sequence of events with random combination of probability values is applied to determine the probability distribution.
Parametric Sensitivity Analysis: mainly used to evaluate the importance of variables in a system.

WHAT DO YOU GET?

Uses and limitations: Probabilistic forecasting can be applied only where the possible outcome can be defined beforehand.

Form(s) of Output: Graphs or tables with best estimates or probabilities and indications of limits, range, or error.

Level of Detail: Detailed numerical results for technical, scientific problems.

Level of Confidence: High for the purpose of scientific calculations. Forecasts dependent on subjective estimates.

Span of Forecast: Short to medium.

HOW DO YOU DO IT?

Procedures: Application of specific assumptions and equations for each of the various techniques.

WHAT DO YOU NEED?

Data requirements and availability: Understanding of the problem and the correct technique to apply - data not usually a limitation.

People, Including Organizational Back-up: Statisticians and analysts.

Time: Short for application.

Money: Small to medium. May require computer backup.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: NORMEX

Definition/description: Because this approach applies exploratory (trend extrapolation) techniques to obtain a normative (that is, need or goals oriented) type of forecast, the technique was termed "NORMEX" forecasting. The tool is based on a mathematical procedure that allows the planner to predict the future relationships expected to exist between goals and existing trends.

History/degree of provenness/promise: Wade Blackman presented mathematical procedures in early 1970s and applied term Normex to earlier (1968) studies of technology and market demand of the computer memory market. Has since been used in industrial marketing studies. (More info needed for other applications but main uses so far are on technological performance).

WHAT DO YOU GET?

Uses and limitations: Allows planners to resolve the interfacing problem between two forecasts and provides an improved indication of the future. Can serve to establish goals and priorities for programs necessary to achieve the requirements demanded by the "market" in a specified future time period. Also useful to indicate tradeoffs and measure uncertainty associated with future forecasts.

Form(s) of Output: Time series extrapolations, frequency distributions, cumulative frequency distributions and graphs of means and standard deviations of selected parameters over time.

Level of Detail: Detailed studies of specific problem. However, sounds like it could be expanded to broader scope planning.

Level of Confidence: Provides useful consistency checks of several forecasts. However there is still uncertainty and this technique assumes that current trends will continue.

Span of Forecast: Medium to long term.

HOW DO YOU DO IT?

Procedures: (1) Collect historical data; (2) construct histograms (frequency distributions); (3) plot cumulative frequencies on log normal probability paper; (4) estimate mean and standard deviation from Step 3; (5) plot means, etc., versus time and extrapolate; (6) apply Normex equation to values from Step 4 along eith extrapolation of historical data from Step 1.

WHAT DO YOU NEED?

Data requirements and availability: Historical data for selected parameters.

People, Including Organizational Back-up: Understanding of some mathematics and statistics.

Time: Short to medium.

Money: Low level effort to apply technique to existing data.

FORECASTING EVALUATION FORM #1

WHAT IS IT?

Name: SUBSTITUTION FORECASTING

Definition/description: This is a means for predicting the substitution of an existing technology by a new technology. The underlying theory is that one technology (without a major change in function) will displace another as predicted by a hyperbolic tangent function based on the annual rate of displacement.

History/degree of provenness/promise: Method has been used extensively in estimating future market size, need for production facilities, phase-out of old technologies, etc. The technique is far from proven because of several important limitations.

WHAT DO YOU GET?

Uses and limitations: Useful for systematic analysis of impacts of changing technologies. Predictions based on the first 5-10% displacement are suspect; they appear to be much more accurate if based on 25% of more substitution. Units of measurement must be carefully selected. The long time spans involved in many displacements means that traditional rates are often distorted by environmental change and/or still newer technologies.

Form(s) of Output: Curves fitted to formulae; tables; discussions of primary and secondary impacts of competing technologies.

Level of Detail: Usually intermediate level of detail, such as displacement of sail by steam ships or of steel by plastic in auto construction. In theory can be detailed or gross.

Level of Confidence: In well-established relationships reasonably well-advanced, confidence is high. Very often, however, conclusions are reached too early in the substitution, much lowering the confidence level.

Span of Forecast: Ranges from near-term to a century or more.

HOW DO YOU DO IT?

Procedures: On the basis of history one calculates the take-over rate. This formula is applied, sometimes with judgmental adjustment, to predict the future. The procedure is clearly one type of trend extrapolation.

WHAT DO YOU NEED?

Data requirements and availability: Need historical time series in enough detail to support mathematical analysis. Such data are frequently available.

People, Including Organizational Back-up: Skill level is not high.

Time: Data collection and analysis is more time consuming than the projecting. Overall time depends on ease with which data can be obtained.

Money: Depends on time. In a few cases substitution forecasting might be done for a few hundred dollars. Many thousands would be required in more time-consuming circumstances.

Mitchell, Arnold
Description of 73 forecasting techniques / Arnold Mitchell, Burnham H. Dodge...[et al.]. -- Fort Belvoir, Va. : U.S. Institute for Water Resources, 1977.
74 p. (IWR contract report ; no. 75-7, Supp. (Part 1))
This supplement to the Handbook of forecasting techniques (IWR contract report 75-7) is in two parts.
1. Forecasting. 2. Simulation. I. Title. II. Dodge, Burnham H., joint author. III. Series: U.S. Institute for Water Resources. Contract report 75-7. Supp. (Part 1).

HD1694 .A42 U584 no. 75-7, Supp. (Part 1)